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CONNECTIVE AND TEGUMENTARY SYSTEMS AND PECULIARITIES.

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Division I.

ORGANS IN PLANTS AND ANIMALS FOR THE SPECIAL PURPOSES OF THE INDIVIDUAL.

Subdivision IX.

CONNECTIVE SYSTEM.

Series I. Adipose Substance.

"FAT is no part of an animal: for first, it is not an animal substance; secondly, an animal is the same without it as with it,—it is to be considered as an adventitious matter; and thirdly, it is found both in vegetables and minerals, and therefore is a substance common to every class of matter.

"In vegetables it is in considerable quantity, especially in the seeds. How far this becomes a preservation for the seed till it grows, I will not at present say.

"Fat is a substance which is solid or fluid according to the degree of heat. It is immiscible with water, and inflammable.

"The term 'Fat' in animals I shall at present make the generic name.

"The fat of animals in the medium temperature of this country, which I shall call 60° Fahr., may be divided into four kinds with respect to fluidity.

"The first I shall call Oil.

"The second, Lard.

"The third, Tallow.

"The fourth, Spermaceti.

"But the seasons are often so cold as to destroy some of these distinctions; for instance, the winter often crystallizes the oils into lards, and lards almost into tallow; but the summers are, I believe, never so hot as to melt lard into oil.

"Animal, or fresh-drawn neat's-foot, oil becomes opake at 50° or at 44°, when it is thicker than hog's lard; it is fluid in a heat above 55°.

"Lard is fluid in a heat above [97°] and solid under that. Tallow is fluid in a heat above [137°] and solid under that. Spermaceti is fluid in a heat above [115°] and solid in a cold under that [at 112°]*.

"Some of these substances are peculiar to some animals, and others are almost common to all.

"The first is the most universal, many animals having no other fat than oil, while there are but few animals without it, although they may be also possessed at the same time of either the second, third, or fourth kinds of fat.

"Oil alone, I believe, is found in Fishes and in some of the Whale tribe, as the Whalebone Whale, Porpesse, &c.

"Lard, I believe, is seldom found alone; it is in general found in common with oil. It is, however, found alone in some, as in the Human subject. Lard is found in the Hog, in the Horse, in the Human subject, and, I believe, in most Birds; as also in the Snake, Lizard, and likewise, I believe, in the Turtle.

"In the feet of the Horse and the Hog is found oil; and I am not cer-

* These spaces are left blank in the manuscript, Mr. Hunter apparently not having made the experiments when he wrote the paragraph: this is also evidenced by his placing spermaceti after tallow in the order of melting points apparently from *à priori* conjecture, of the incorrectness of which he was, however, evidently aware when he wrote his paper 'On Whales' (Phil. Trans. 1787.), where he states that 'tallow congeals with rather less cold than spermaceti,' p. 393.

tain if it is not oil which is found in the legs and toes of the Goose, Duck, &c., but this is not the case in the Human.

"Tallow is found in the Ruminants, I believe in every one of that order. The Camel has it. In the feet of many, if not of all the Ruminants, is also found oil.

"Spermaceti is only found in one species of the Whale. In the same species is found oil, and I believe this is the fat of all the others of this tribe.

"Besides those above described, there are fats of an intermediate consistence. The fat of a Dog, Cat, &c., is firmer than hog's-lard, but is softer than tallow.

"In some of those animals which have two kinds of fat, it is in some places distinct and in others mixed.

"*Situation of the Fat.*

"Fat is differently situated in different animals.

"It is either universal or partial.

"In Fish there are two situations of fat. In many species the fat is diffused principally through the whole body, intermixed with the muscles, &c.; also in the abdomen or mesentery, as we find to be the case in the Salmon, Trout, Herring, Sprat, Pilchard. In others it is only to be found in the liver, as in the Cod, Whiting, Haddock, as also in all of the Ray kind, I believe without exception.

"In the Amphibia, the fat is, I believe, principally found in the cavity of the abdomen; and, according to the kinds of Amphibia, it is found there in particular parts and in particular forms. In the Frog, Toad, Chameleon, &c., it is found in several long appendages, like the appendiculæ epiploicæ in the human subject, situated on each side of the spine, being attached to it by one of their ends, while the others float loose in the abdomen. In the Snake it is found all along the intestines. In the Lizard it is found in two large lumps, one on each side of the abdomen, near to the posterior end, or pelvis.

"In the Fowl the fat is principally found between the peritoneum and muscles of the cavity of the abdomen; being very little diffused through

the interstices of the muscles. However, some is placed immediately under the skin in several places. In the bones of the legs, toes, last bones of the wings, as also in the bones of the tail, there is a considerable quantity of fat, especially in the Swimming Tribe.

" In the Quadrupeds which have fat, it is found everywhere in the body. It is found in the spaces between the muscles, and between the fibres of a muscle itself; in the mesentery, about the kidneys, heart, &c.

" But many animals have it more in one place than another; thus the Whale-kind, Hog, Hedgehog at the beginning of winter, and Man, have it in the greatest quantity immediately under the skin; more especially the Whale tribe, for they have none in their abdomen, mesentery, &c.; while others have it more unevenly mixed, as the Horse, Ox, Sheep. However, these two last have it more about the kidneys, the loins, and within the abdomen than most other animals: perhaps this disposition of the fat is peculiar to the Ruminants.

" There are some quadrupeds that can hardly be said to have any fat at all, as the Hare.

" In some parts of some animals no fat is to be seen, such as the scrotum and eyelids in Man.

" *Formation of Fat.*

" Fat is a secretion from the blood, and not any fat that may have been eaten; for from the account above related, the fat of the animal is in some degree peculiar to itself, which could not be the case if it were only a deposition of other fats.

" Mr. Burdett, not above five feet three inches high, who was in the Black-hole at Calcutta, after coming home, grew so fat that he weighed twenty-five stone. The calf of his leg measured two feet four inches round, and the small, one foot eight inches and a half.

" *Of its Use.*

" As fat does not appear to have any immediate use in the animal œconomy, it becomes difficult to assign all the uses it may be of; for as some animals have a good deal, as the Hog, and others none at all, as the Hare,

and as we cannot *à priori* say, from any knowledge we have of the manner of living of the two animals, that the one should have fat and the other not ; nor can we *à posteriori* see why there should be any difference between them in this respect, we must inquire into any secondary use it may be of.

"Although the use of the fat in animals is perhaps not to be ascertained, yet we may in some measure give some reasonable conjecture about it.

"That a certain quantity of fat is in general necessary in an animal in perfect health is evident, for we find few animals in perfect health and vigour but what have more or less fat, excepting the Hare ; and when they become unhealthy they lose their fat and become lean, and remain so while health does not return. Fat then, in a certain quantity, is an attendant upon health.

"Why an animal should become leaner in the time of disease we might at first view easily assign a reason for, viz., that as in such a state an animal does not take food in the same quantity that it does in health, therefore the fat is absorbed to support the actions of the machine while in such a state ; especially too, as in animals that are fat, and are reduced to a small allowance of food, we find that the fat is absorbed, which we may reasonably suppose supplies in some degree the want of common food : but this does not appear to be the case in diseases, for an unhealthy animal appears to live as well with the same quantity of food after all the fat is gone as before ; he does not now appear to require more food, nor does he seem to sink faster under his disease after this mode of nourishment is gone than before, which I think would be the case if it was a reservoir for support under disease, as it would appear to be under certain circumstances in health.

"Why fat and disease should be incompatible with one another would therefore appear not easily accounted for, but so it is.

"The use of fat or oil in an animal body would appear to be of three kinds : nourishment, production of heat, and retention of heat.

"The apparent use of fat is not universal, and therefore may be supposed to be doubtful ; but it would appear in several to be, without

doubt, a guard or a preventive against cold. Under such an idea, let us consider this matter*.

"First, we find that animals which are not endowed with much hair have a considerable quantity of fat, and that more superficial than in other animals. The Human subject and the Hog are remarkable instances of this, which are similar with respect to hair. Elephants and Rhinoceroses when fat I have never seen.

"The Seal tribe, where the hair is very short, and which live principally in cold water, have a vast quantity of fat between the skin and muscles, and in which it would appear to answer no other purpose than that of assisting in preserving the natural heat of the animal†.

"In the Whale tribe, where there is no hair at all, the same observations stand in fuller force; and all of this class of animals have little or no fat on their inside, the mesentery being perfectly clear of it in the fattest; or in the interstices of the muscles.

"The epiploon would appear to answer the purpose of warmth; and most animals that have fat have it covering the intestines, excepting the last-mentioned animals.

"That it is of any mechanical use in the machine, viz. for the motion of one part or muscle upon another, we can hardly suppose; for these actions are equally well carried on in the lean animals, as the Hare, as in the fat ones, viz. the Hog. We find also that the fat of a Cod is in its liver, while a Salmon has it diffused through the body, both appearing equally to want it, if it assisted in the motion of the animal.

"Besides, the manner in which it is collected does not appear to favour the idea of its rendering the motion of the muscles, or any other part, more easy; and in the Elephant there are accumulations of a calcareous earth similar to fat, which we can hardly suppose to answer the purpose of nourishment, and would also appear to be ill suited for the motion of one part upon another.

"* Perhaps under this idea no other animal can with propriety be considered but that which is commonly called quadruped."

"† It may be supposed that the fat serves here as an air-bladder, it being specifically lighter than water, especially sea water."

"The mediate use of fat is undoubtedly as food.

"We find all animals grow lean if not allowed a sufficient quantity of food for the actions of the machine, so that the reservoir of fat is begun upon whenever the nourishment falls short of the necessary quantity; and the animal of course becomes leaner and leaner, which is in proportion to the necessity.

"But this reason for the accumulation of fat is still further illustrated in those animals that are by nature allotted for living a certain time of the year without food.

"We find that those animals which do not find their food through the whole year in the same place, and are themselves stationary, have accumulated a considerable quantity of fat by the time that the abstinence from food comes on; and that those animals when they again appear, have almost consumed their accumulated fat. So that this fat has been in part sufficient* to support the diminished actions of the animal, which were only the involuntary actions, the voluntary actions being all suspended in such a state†.

"This fact would appear to have been taking place in a Spermaceti Whale which was caught in the mouth of the river Thames. He had been in the channel some time, where we may suppose he had but little food, and that an absorption of his fat had taken place; for on dissecting him I found several plexuses of vessels, some as large as my finger, filled with oil and spermaceti‡. What these were I do not absolutely say, but it is not reasonable to suppose them anything else but the absorbents, for the arteries and the veins were certainly out of the question, and we know of no other vessels.

"But to ascertain this fact as far as possible, I desired Mr. Jenner, surgeon at Berkley, to examine Hedgehogs at the beginning and termination of the winter, and the following are the results of his examinations.

"* For here we must take into the account the other wastes of the machine, such as the muscles becoming smaller."

"† Quære. Do the involuntary actions require less nourishment than the voluntary?"

‡ See Preparation No. 862.

" ' *Experiment* 1. October4, 1778.—I examined a Hedgehog which was taken from the fields the evening before; I found the animal exceedingly fat. There was a very thick layer of fat between the skin and the muscles on every part except the head and legs. The mesentery and epiploon had fat about them, but were not loaded with it. The kidneys lay upon a large bed of fat, but had none of this substance upon their superior part. The thick layer of fat mentioned above, between the skin and muscles, lay very loose, and was but very slightly attached to either.

" ' *Experiment* 2. February 1, 1779.—The heat of the atmosphere 50°. I examined another Hedgehog. This animal was drowned, and upon dissection exhibited the following appearances: a thin layer of fat between the skin and external muscles, of a yellowish hue, not more than a third part of the quantity observed in the first dissection. There was but a small quantity of fat about the mesentery and kidneys. In the stomach and intestines there was not the least appearance of food. The animal was found sheltered in a hollow place in a bank, and covered over with leaves, &c. The place was carefully examined, and no kind of food was discovered round about it.

" ' *Experiment* 3. March 1.—I examined another Hedgehog. On dissecting this animal I found that its fat was nearly exhausted. There was not the least appearance of it in the abdomen, neither about the mesentery or kidneys. The whole quantity that remained was between the skin and muscles, and there it was in a very small proportion. This circumstance is strongly in favour of the idea of fat being placed externally as a covering from cold.

" ' *Experiment* 4. March 21.—I dissected two Hedgehogs taken fresh from the fields. One was a large full-grown animal, and pretty full of fat about the skin and abdomen. I expected on seeing so much fat to have found food in the stomach and intestines; however there was none in either.

" ' *Experiment* 5. April 18.—This animal had not begun to recover its fat. The small quantity remaining was of a brownish yellow colour.

" ' *Experiment* 6. July 12.—The atmosphere in the shade was 78°.

This animal exhibited the same appearances on dissection as the above-described one of April 18, being very lean, &c."

Hunterian manuscript Catalogue.

Subseries 1. *Oil.*

1800. Animal, or Neat's-foot oil.

1800 a. Dippel's animal oil. *Presented by Professor Brande, F.R.S.*

1801. Oil of the Pilchard (*Clupea Pilchardus*, Bloch).

1802. Oil of the Salmon (*Salmo Salar*, Linn.). In these species the oil is diffused through the body.

1803. Oil of the Pike (*Esox Lucius*, Linn.).

1803 a. Oil of the Basking Shark (*Selache maxima*, Cuv.), taken from the liver, in which viscus the oil is accumulated in great quantity.

Presented by Mr. Clift.

1803 b. Oil of Eggs. This is contained in the yolk, and gives the peculiar colour to that part, which before its deposition is white and sub-transparent. *Presented by Professor Brande, F.R.S.*

1803 c. Empyreumatic Oil, prepared from butter.

Presented by Professor Brande, F.R.S.

1804. Oil of the Seal (*Phoca Vitulina*), similarly prepared.

1805. Oil of the Spermaceti Whale (*Physeter macrocephalus*, Shaw).

1806. Oil of the Whalebone Whale (*Balæna Mysticetus*, Linn.).

1807. Oil of the Whale prepared, forming the purified train-oil of commerce.

1808. A portion of the adipose tissue, or blubber, from beneath the integuments of a Whale (*Balæna Mysticetus*, Linn.).

Of this structure Mr. Hunter gives the following description.

"The fat of this order of animals, except the Spermaceti, is what we generally term oil. It does not coagulate in our atmosphere, and is probably the most fluid of animal fats; but the fat of every different order of animals has not a peculiar degree of solidity, some having it in the

same state, as the Horse and Bird. What I believe approaches nearest to spermaceti, is the fat of ruminating animals, called tallow.

"The fat is differently situated in different orders of animals, probably for particular purposes, at least in some we can assign a final intention. In the animals which are the subject of the present paper it is found principally on the outside of the muscles, immediately under the skin, and is in considerable quantity. It is rarely to be met with in the interstices of the muscles, or in any of the cavities, such as the abdomen or about the heart.

"In animals of the same class living on land, the fat is more diffused; it is situated, more especially when old, in the interstices of the muscles, even between the fasciculi of muscular fibres, and is attached to many of the viscera; but many parts are free from fat, unless when diseased, as the penis, scrotum, testicle, eyelid, liver, lungs, brain, spleen, &c.

"In Fishes its situation is rather particular, and is most commonly in two modes; in the one, diffused through the whole body of the fish, as in the Salmon, Herring, Pilchard, Sprat, &c.; in the other, it is found in the liver only, as in all of the Ray kind, Cod, and in all those called White-fish, there being none in any other part of the body*. The fat of fish appears to be diffused through the substance of the parts which contain it, but is probably in distinct cells. In some of these fish, where it is diffused over the whole body, it is more in some parts than others, as on the belly of the Salmon, where it is in larger quantity.

"The fat is differently inclosed in different orders of animals. In the quadruped, those of the Seal kind excepted, in the Bird, Amphibia, and in some Fish, it is contained in loose cellular membrane, as if in bags, composed of smaller ones, by which means the larger admit of motion on one another and on their connecting parts, which motion is in a greater or less degree as is proper or useful. Where motion could answer no purpose, as in the bones, it is confined in still smaller cells. The fat is in a less degree in the soles of the feet, palms of the hands, and in the breasts of many animals. In this order of animals and the Seal kind, as

"* The Sturgeon is, however, an exception, having its fat in particular situations, and in the interstices of parts, as in other animals.

far as I yet know, it is disposed of in two ways; the small quantity found in the cavities of the body and interstices of parts is in general disposed in the same way as in quadrupeds; but the external, which includes the principal part, is inclosed in a reticular membrane, apparently composed of fibres passing in all directions, which seem to confine its extent, allowing it little or no motion on itself, the whole, when distended, forming almost a solid body. This, however, is not always the case in every part of animals of this order; for under the head, or what may be rather called neck, of the Bottle-nose, the fat is confined in larger cells admitting of motion. This reticular membrane is very fine in some, and very strong and coarse in others, and even varies in different parts of the same animal. It is fine in the Porpesse, Spermaceti, and large Whalebone Whale; coarse in the Grampus and small Whalebone Whale *: in all of them it is finest on the body, becoming coarser towards the tail, which is composed of fibres without any fat, which is also the case in the covering of the fins. This reticular network in the Seal is very coarse; and in those which are not fat, when it collapses, it looks almost like a fine net with small meshes. This structure confines the animal to a determined shape, whereas, in quadrupeds, fat, when in great quantity, destroys all shape.

"The fat differs in consistence in different animals and in different parts of the same animal, in which its situation is various. In quadrupeds some have the external fat softer than the internal, and that inclosed in bones is softest nearer to their extremities.

"Ruminating animals have that species of fat called tallow, and in their bones they have either hard fat or marrow, or fluid fat called neat's-foot oil.

"In this order of animals the internal fat is the least fluid, and is nearly of the consistence of hog's-lard; the external is the common train oil: but the Spermaceti Whale differs from every other animal I have examined, having the two kinds of fat just mentioned, and another which is totally different, called spermaceti, of which I shall give a particular account."—*Hunter, On Whales. Philosophical Transactions*, 1787, p. 387.

"* Where it is fine it yields the largest quantity of oil, and requires the least boiling."

1809. A section of the lateral muscular parts of the Sturgeon (*Acipenser Sturio*, Linn.), showing the adipose tissue in the interstices of the same, as described by Mr. Hunter in the note in the preceding extract.

2. *Marrow.*

1810. A section of the lower extremity of a Human femur, from which a portion of the bony parietes has been removed, to expose the medullary cavity and its contents. The medullary artery, or arteria nutritia as it is sometimes called, is filled with fine injection, and its ramifications may be seen spreading among the large cells formed by the medullary membrane. The vascularity of the membrane lining the cavity of the bone is not demonstrated by this injection.

1811. Three transverse sections of the metatarsal bone of an Ostrich (*Struthio Camelus*, Linn.), from each of which a portion of the osseous parietes has been removed, to expose the medulla. The cells of the reticulate medullary membrane are best seen in the upper section: they are relatively smaller than in the preceding specimen.

The bones of all birds contain in the first instance a medulla, which is afterwards displaced in most of the species, to make room for the air-cells, as happens also in certain bones of the Ostrich, as in the femur. See Nos. 214—217.

1812. A compact portion of marrow from the cavity of a large cylindrical bone. A portion of the external medullary membrane is turned down, showing its delicate transparent texture and small degree of vascularity: the medullary artery has been injected. Its size and course indicates the preparation to have been taken from the upper extremity of a tibia.

3. *Lard.*

1813. A bottle containing some prepared Hog's-lard (*Adeps Suillæ*).

1813 a. The oily part of Butter, which retains the consistency of lard at the ordinary temperature of our climate.

Presented by Professor Brande, F.R.S.

1814. The abdominal viscera of a Salamander (*Salamandra maculosa*, Laur.),

showing the two lateral ramified processes of the peritoneum loaded with a quantity of dark-coloured fat or lard.

1815. A Frog (*Rana temporaria*, Linn.), with the parietes of the abdomen and principal viscera removed, to show the two adipose processes of the peritoneum, which here present an elongated and fimbriated form.

1816. The peritoneal adipose processes of a Frog.

1817. The corresponding adipose processes from the abdomen of the Surinam Toad (*Pipa monstrosa*, Laur.).

1818. Dark-coloured fat from the abdomen of a Batrachian Reptile.

1819. A portion of the peritoneal or omental adipose processes from the abdomen of a Rattle-snake (*Crotalus horridus*, Linn.).

1820. The corresponding omental adipose processes of a large Serpent (of the genus *Pseudoboa*, Oppel.). The adeps is here collected in flattened masses of an irregularly rounded or oval form, varying in size from half an inch to an inch and a half in diameter.

1820 a. The urinary bladder and peritoneal adipose processes of an Iguana (*Iguana tuberculata*, Linn.). These are two in number, of large size, of a broad flattened elongated form, divided each into an upper and a lower lobe, and attached by a narrow process to the sides of the bladder near its neck, whence they advance forwards, and float freely in the abdominal cavity. *Presented by Mr. Owen.*

1821. A portion of the peculiarly coloured green fat from the abdomen of a Turtle (*Chelonia Mydas*, Linn.). It has communicated the green tinge to the spirit.

1822. A Swallow or Martin (*Hirundo*), with the parietes of the abdomen removed, to show the adipose substance in the mesentery and interstices of the intestines. The bird was killed in the month of April, when the quantity of fat accumulated in this situation may be expected to be smallest.

1823. Two large masses of adeps, accumulated in processes of the peritoneum,

which are situated behind the bladder and uterus of an American Opossum (*Didelphis virginiana*, Linn.). These fatty processes are similar to those in the abdomen of the Iguana.

1824. The great omentum of a Racoon (*Procyon Lotor*, Linn.), showing the reticulate deposition of the adipose substance in that part.

1825. The Human umbilicus, showing the accumulation of the adipose substance around the remains of the umbilical vessels, between the integument and the abdominal muscles.

4. *Tallow.*

1826. A section of the kidney of a Sheep (*Ovis Aries*, Linn.), with the surrounding mass of firm adipose substance called Tallow.

1827. The opposite section of the same kidney, which is partly turned down, to show the smooth bed formed for it by the surrounding tallow.

1828. Tallow from a Sheep, extracted from the cells of the adipose tissue.

5. *Spermaceti.*

1829. A portion of the subcutaneous adipose and cellular texture from the Spermaceti Whale (*Physeter macrocephalus*, Shaw). It is stated to have been taken "from the head, near the anterior part, where it is most mixed with oil, and where the cells which contain it are strong and tendinous."

1830. A portion of the subcutaneous adipose texture of the same Spermaceti Whale, showing the two distinct substances which it contains, namely, the oil, which floats uppermost in the spirit, and the spermaceti, which is below, but still floats in consequence of the oil which is mixed with it.

This preparation "was taken from the head, nearer to the neck or body than the first, and is considerably purer."

1831. A similar portion "of the most pure, which comes from all along the upper part of the head, above the blow-hole." In this preparation the oil has been extracted from the spermaceti, which, in consequence of its

greater specific gravity, has sunk to the bottom of the bottle. Its crystallized structure is well shown.

" What is called spermaceti is found everywhere in the body in small quantity, mixed with the common fat of the animal, bearing a very small proportion to the other fat. In the head it is the reverse, for there the quantity of spermaceti is large when compared to that of the oil, although they are mixed, as in the other parts of the body.

" As the spermaceti is found in the largest quantity in the head, and in what would appear on a slight view to be the cavity of the skull, from a peculiarity in the shape of that bone, it has been imagined by some to be the brain.

" These two kinds of fat in the head are contained in cells, or cellular membrane, in the same manner as the fat in other animals; but besides the common cells there are larger ones, or ligamentous partitions going across, the better to support the vast load of oil, of which the bulk of the head is principally made up.

" There are two places in the head where this oil lies; these are situated along its upper and lower part: between them pass the nostrils, and a vast number of tendons going to the nose and different parts of the head.

" The purest spermaceti is contained in the smallest and least ligamentous cells: it lies above the nostril, all along the upper part of the head, immediately under the skin, and common adipose membrane. These cells resemble those which contain the common fat in the other parts of the body nearest the skin. That which lies above the roof of the mouth or between it and the nostril, is more intermixed with a ligamentous cellular membrane, and lies in chambers whose partitions are perpendicular. These chambers are smaller the nearer to the nose, becoming larger and larger towards the back part of the head, where the spermaceti is more pure.

" This spermaceti, when extracted cold, has a good deal the appearance of the internal structure of a water melon, and is found in rather solid lumps.

" About the nose, or anterior part of the nostril, I discovered a great many vessels, having the appearance of a plexus of veins, some as large

as a finger. On examining them, I found they were loaded with the spermaceti and oil; and that some had corresponding arteries. They were most probably lymphatics; therefore I should suppose that their contents had been absorbed from the cells of the head. We may the more readily suppose this, from finding many of the cells, or chambers, almost empty; and as we may reasonably believe that this animal had been some time out of the seas in which it could procure proper food, it had perhaps lived on the superabundance of oil.

"The solid masses are what are brought home in casks for spermaceti.

"I found, by boiling this substance, that I could easily extract the spermaceti and oil which floated on the top from the cellular membrane. When I skimmed off the oily part, and let it stand to cool, I found that the spermaceti crystallized, and the whole became solid; and by laying this cake upon any spongy substance, as chalk, or on a hollow body, the oil drained all off, leaving the spermaceti pure and white. These crystals were only attached to each other by edges, forming a spongy mass; and by melting this pure spermaceti, and allowing it to crystallize, it was reduced in appearance to half its bulk, the crystals being smaller, and more blended, consequently less distinct.

"The spermaceti mixes readily with other oils, while it is in a fluid state, but separates or crystallizes whenever it is cooled to a certain degree; like two different salts being dissolved in water, one of which will crystallize with a less degree of evaporation than the other; or, if the water is warm, and fully saturated, one of the salts will crystallize sooner than the other, while the solution is cooling. I wanted to see whether spermaceti mixed equally well with the expressed oils of vegetables when warm, and likewise separated and crystallized when cold, and on trial there seemed to be no difference. When very much diluted with the oil, it is dissolved or melted by a much smaller degree of heat than when alone; and this is the reason, perhaps, that it is in a fluid state in the living body.

"If the quantity of spermaceti is small in proportion to the other oil, it is, perhaps, nearly in that proportion longer in crystallizing; and when it does crystallize the crystals are much smaller than those that are formed

where the proportion of spermaeeti is greater. From the slowness with whieh the spermaceti erystallizes when much diluted with its oil, from a considerable quantity being to be obtained in that way, and from its eontinuing for years to crystallize, one would be induced to think that perhaps the oil itself is converted into spermaceti.

" It is most likely that if we could diseover the exact form of the different erystals of oils, we should thenee be able to aseertain both the different sorts of vegetable oils, expressed and essential, and the different sorts of animal oils, mueh better than by any other means; in the same manner as we know salts by the forms into which they shoot.

" The spermaeeti does not become raneid or putrid, nearly so soon as the other animal oils, whieh is most probably owing to the spermaceti being for the most part in a solid state; and I should suppose that few oils would beeome so soon raneid as they do, if they were always preserved in that degree of eold whieh rendered them solid: neither does this oil become so soon putrid as the flesh of the animal; and therefore, although the oil in the eells appeared to be putrid before boiling, it was sweet when deprived of the eellular substanee. The spermaeeti is rather heavier than the other oil.

" In this animal then we find two sorts of oil, besides the deeper seated fat, eommon to all of this class; one of whieh erystallizes with a mueh less degree of eold than the other, and of course requires a greater degree of heat to melt it, and forms, perhaps, the largest crystals of any expressed oil we know: yet the fluid oil of this animal will crystallize in an extreme hard frost, mueh sooner than most essential oils, though not so soon as the expressed oils of vegetables. Camphire, however, is an exeeption, sinee it erystallizes in our warmest weather, and when melted with expressed oil of vegetables, if the oil is too mueh saturated for that particular degree of eold, erystallizes exaetly like spermaceti.

" In the Ox the tallow, and what is called Neat's-foot oil, crystallize in different degrees of cold. The tallow eongeals with rather less eold than the spermaeeti; but the other oil is similar to what is ealled the train oil in the Whale.

" I have endeavoured to discover the form of the crystals of different

sorts of oil, but could never determine exactly what that was, because I could never find any of the crystals single, and by being always united the natural form was not distinct." *Hunter on Whales*, p. 390.

6. *Adipocere.*

1832. Portions of the muscles of a Goose changed after death into adipocere.

This preparation is described in the 82nd volume of the *Philosophical Transactions* (1792, p. 197.). The bird—conjectured to be a young Goose—was found at the head of a fish-pool having a small brook running into it; and its soft parts were converted into a substance "resembling spermaceti in its consistence between the teeth, but having neither taste nor smell. It melts in a small heat, and when congealed again becomes more solid, and looks like wax. In a greater heat it burns and emits a strong animal smell."—*On the Conversion of the Substance of a Bird into a hard fatty matter*, by Thomas Sneyd, in a letter to Sir Joseph Banks, P.R.S.

1832 A. A section of the muscles of a Horse similarly changed into adipocere. *British Museum.*

1832 B. The last cervical and three superior dorsal vertebræ, with portions of the corresponding ribs, and the surrounding soft parts, of a Human subject, showing the muscular, cellular, and tegumentary systems similarly converted into adipocere. *Presented by Professor Kidd, F.R.S. Oxford.*

1832 C. A portion of the skin and muscles from the Human abdomen of the same subject. *Presented by Professor Kidd, F.R.S. Oxford.*

1832 D. The femur and surrounding soft parts of the same subject, showing a similar conversion of all the textures into the same homogeneous substance. *Presented by Professor Kidd, F.R.S. Oxford.*

1832 E. A portion of the foot of the same subject. *Presented by Professor Kidd, F.R.S. Oxford.*

Adipocere is most commonly obtained by exposing the soft parts of animals to the action of running water. It is formed, under certain morbid circumstances, in the living body, but is not to be regarded, like the

modifications of adeps, as a natural product. The change of muscular tissue into adipocere is most rapidly effected by the immersion of animal matter in dilute nitrous acid. The preparations Nos. 1832 B, C, D, and E, were parts of a subject which had been used for anatomical demonstration at Oxford, and afterwards thrown into a receptacle of the depth of about thirteen or fourteen feet, and through which a small stream of water passes.

The melting point of pure adipocere is 112°. The adipocere procured from human muscle crystallizes into flakes when placed in boiling alcohol and afterwards cooled; while that which is obtained from quadrupeds seems not disposed to crystallize. By a somewhat elaborate process it can be deprived entirely of its offensive odour, and bleached almost to the whiteness of spermaceti, which it then closely resembles in all its properties. See *Gibbes in Phil. Trans. vols.* lxxxiv. *and* lxxxv. *On the Conversion of Animal Substance into Fatty Matter much resembling Spermaceti.*

Series II. Cellular Substance.

1833. A Toad (*Bufo vulgaris*, Laur.), with part of the parietes of the back removed to show the lax and sparing cellular texture which connects the skin to the subcutaneous muscles.

1834. A Toad, with the integuments of the abdomen removed to show the similarly lax subcutaneous cellular tissue of that part.

1835. A section of the Human scrotum, showing the loose and abundant subcutaneous cellular texture of that part.

1836. A section of the Human scrotum and penis, showing the condensed layer of cellular texture which forms the septum scroti. No adeps is ever deposited, under any circumstances, in the cellular texture of this part of the body.

1837. A section of the condensed elastic cellular substance from beneath the integument covering the sternum of the Dromedary (*Camelus Dromedarius*, Linn.).

1838. The condensed and elastic cellular substance from the sole of the foot of a Dromedary.

1839. The thickened and condensed cellular substance which surrounds the large bursa mucosa, which is situated in front of the carpal joint or fore-knee of the Dromedary.

1840. A section of the condensed cellular texture which forms the hump of the Dromedary.

1841. A section of the dorsal fin of the great Bottle-nose Whale (*Hyperoodon Dalei*, Cuv.), showing the condensed and ligamentous nature of the cellular substance of which that part is composed. The corium is here more distinctly separated from the subjacent cellular texture than in other parts of the body. It rests upon a stratum of ligamentous fibres, obliquely but regularly decussating each other, with the diagonal line perpendicular to the surface of the fin : it is about half the thickness of this stratum, and is composed of a compact substance, in which no arrangement of fibres is discernible. The external surface of the corium is villous, the villi entering into corresponding depressions of the cuticle, part of which has been removed.

1842. A section of the integument, with the subcutaneous cellular substance from the side of the body of the same animal, showing the close and firm texture of the cellular substance at this part, and the interspaces formed by the decussation of its ligamentous fibres for the lodgement of the oil.

1843. A section of the coarse and ligamentous subcutaneous cellular texture from the back of the same animal.

1844. A section of the tail of the Piked Whale (*Balæna Boops*, Linn.), showing the condensed fibres of the cellular tissue passing perpendicularly to the strata of tendinous fibres, which cover them both above and below, and to show which a portion of the integument has been removed on both sides.

1845. A section of a small portion of the same caudal fin. The corium is remarkably distinct from the subjacent cellular texture, differing in colour, in the arrangement of its fibres, and in the superior density of its texture. A section of it with part of the cuticle has been removed.

"*Of the Construction of the Tail.*

"The mode in which the tail is constructed is perhaps as beautiful as to the mechanism as any part of the animal. It is wholly composed of three layers of tendinous fibres covered by the common cutis and cuticle; two of these layers are external, the other internal. The direction of the fibres of the external layers is the same as in the tail, forming a stratum about one third of an inch thick, but varying, in this respect, as the tail is thicker or thinner. The middle layer is composed entirely of tendinous fibres passing directly across between the two external ones above described, their length being in proportion to the thickness of the tail; a structure which gives amazing strength to this part.

"The substance of the tail is so firm and compact that the vessels retain their dilated state even when cut across; and this section consists of a large vessel surrounded by as many small ones as can come in contact with its external surface: which of these are arteries, and which veins, I do not know.

"The fins are merely covered with a strong condensed adipose membrane." *Hunter, On Whales, ibid.*, p. 836.

Subdivision X.

TEGUMENTARY SYSTEM.

Series I. The Derm, or Corium.

1846. A section of the corium of an Elephant (*Elephas Indicus,* Cuv.), showing it to be composed of an interlacement of white dense fibres of a ligamentous nature, the interstices of which are occupied by the nervous papillæ, and by the vascular tissues concerned in exhalation, absorption, and the secretion of the colouring and horny materials which form the rete mucosum and cuticle.

1847. A section of the subcutaneous cellular and adipose tissue, with a portion of the integuments, of the large Bottle-nose Whale (*Hyperoodon Dalei*, Cuv.). The cellular texture, which is of a dense ligamentous nature, forms a close fibrous reticulation, in the areolæ of which the oil or blubber is contained; it becomes more condensed and the areolæ are smaller as it approaches the surface of the body, where it forms the corium: the subcutaneous nervous and vascular tissues extend in the form of delicate elongated papillæ beyond the surface of the corium, and are received into corresponding depressions of the cuticle.

1848. A section of the dorsal fin of the same Whale, showing the density of the cellular tissue of the entire part to be equal to that of ordinary corium, which it resembles in texture; but it is also invested with a very distinct compact stratum of dermal substance.

1849. A portion of integument, with the subjacent layers of adipose, cellular, and muscular tissues, of a Porpesse (*Phocæna communis*, Cuv.), showing the condensation of the cellular texture next the surface of the body, forming the cutis. The external layer of cuticle is entirely removed, and the thicker internal layer is in great part reflected from the cutis, showing the fine downy appearance of its external surface, produced by the numerous elongated papillæ, and the thin stratum of pigment deposited between the dermal papillæ and the cuticle, and which is seen adhering to the cavities of the epidermis in which the papillæ were lodged.

1850. A portion of integument from the under part of the body of a Porpesse, showing the cuticle to be divisible into two layers, an external and an internal; the external probably ready to be cast off. The internal layer, or that next the cutis, would appear to be made up of fibres, passing perpendicularly to the surface, but that appearance is owing to the numerous cavities for the reception of the long villi of the cutis. The pigment forms a thin layer of dark-coloured matter beneath the epidermis, but which is not mixed with it or extended to the surface, so as to give colour to that part of the body. The thickness of the laminated cuticle here described is three lines.

1851. A portion of the cuticle of the same animal, showing the two principal

layers of which it is composed, and the internal surface which was in contact with the cutis. The dermal villi having a linear disposition, impress the cuticle with close-set furrows, divided into minute foramina for the villi; the black pigment has been washed away from these cavities.

1852. A portion of skin and blubber of a small Bottle-nose Whale (*Delphinus Tursio*, Fabr.), which is white on the belly; the external cuticle, which is thin, is turned down. The internal cuticle is a line in thickness; it presents a minutely wrinkled surface next the outer layer.

1853. A similar portion taken from the back of the same animal; the external thin cuticle is turned down on one part, and a small square section of the thick cuticle is removed to show the villi of the cutis. The colouring matter is more abundant than in the preceding specimens, being deposited between the cutis and internal layer, and again between the internal and external layers of cuticle, giving the dark colour to the surface of the body.

1854. A piece of the external and internal cuticles from the back of the *Delphinus Tursio*, with the external turned down; showing that the external surface of the internal cuticle, though wrinkled, is smooth and glossy, while the internal surface is perforated for the close-set minute villi of the cutis, to which surface the colouring matter adheres.

1855. A portion of the internal layer of cuticle from the back of the *Delphinus Tursio*. The external surface is smooth and glossy, the internal has innumerable holes for the passage of the villi, which holes are seen upon the edge, extending through the whole length of the internal layer.

1856. A section of the skin from the under part of the body of a Piked Whale (*Balæna Boops*, Linn.), including a portion of two of the tegumentary folds or ribs which characterize this species. The exposed surface of the folds are smooth, but the skin is wrinkled in the interspaces: this section shows two of the folds blending into one.

1857. A transverse section of two of the ventral tegumentary folds of the same Whale, showing the varying thickness of the cuticle at different parts of the fold, and also that it consists of two layers, of which the internal

appears fibrous, as in the preceding specimens, from the extension into it of the villi of the cutis. This structure is plainly seen by a moderately magnifying power. The dark pigment is not secreted in this situation.

1857 A. A portion of the skin of a Whale (*Balæna Mysticetus*, Linn.), showing the great length of the dermal villi. The outer layer of the cuticle is removed from a portion of the integument; the inner layer is in its natural connexion with the villi, which it closely invests. The colouring matter is secreted and deposited at the base of the villi, and extends to their extremities, where it stains the external cuticle.

Presented by Mr. Edwards, Surg. R. N.

1858. A section of the Human skin, showing the effect produced by the stimulus of cold and some mental emotions upon the dermal tissue, which thereby contracts and occasions a corrugation of the surface, vulgarly called 'goose-skin.'

1858 A. A portion of the integument of the abdomen of an aged Female who had borne children, showing the permanent wrinkles produced by the contraction of the corium, after being distended during pregnancy.

Presented by Mr. Owen.

1859. A portion of Human corium, minutely injected, dried, and preserved in oil of turpentine to show its vascularity.

1860. A smaller portion of Human corium, similarly preserved, but not injected.

1860 A. Two portions of Human corium, similarly preserved and injected.

Presented by W. Lawrence, Esq., F.R.S.

1861. "A portion of the skin of the arm of a Man tattooed with gunpowder, in which it would appear as if the cuticle either grew over the substance left in, or that it stained the cutis." The stain thus produced is permanent, the carbonaceous matter not being acted upon by the absorbents.

1862. Two portions of Human skin, similarly tattooed.

1863. A strip of Human integument similarly tattooed, with the cuticle partially reflected to show that the stain is exclusively in the cutis.

1864. The corresponding strip from the same Person, similarly prepared.

1864 A. A section of the skin of a Sailor's arm tattooed with gunpowder, bearing besides the figure the date of the operation, 1786.

Presented by Mr. Clift.

1864 B. A portion of skin from a Sailor's arm, in which the figure of a ship is neatly tattooed: dried and preserved in oil of turpentine.

Presented by Mr. Clift.

1864 C. A portion of skin from the hip of a native of Tahiti, beautifully tattooed with a substance which produces a stain of a deeper blue than gunpowder. *Presented by Mr. Clift.*

1864 D. A portion of skin from the thigh of the same individual.

Presented by Mr. Clift.

1864 E. The skin of the lower half of the leg and ancle of the same individual, elaborately tattooed with the figure of an ornamental sandal.

Presented by Mr. Clift.

Series II. Substances deposited between the Derm and Epiderm.

Subseries 1. *Pigmentum, or colouring matter.*

1865. A section of the skin from the arm of a Boy, to show the darker colour of that part which was exposed to the light, and which is owing to a deposition of a brown pigment between the corium and cuticle.

1866. A section of the skin of an European, from which the external layer of the cuticle is reflected to one side, and a small portion of the internal last-formed layer unstained with the pigmentum is turned down.

1867. A section of the skin of a Mulatto, with both layers of the cuticle and adherent pigment reflected. On the inner surface of the cuticle may be observed the filamentous processes which maintain its connexion with the cutis.

1868. A section of the skin of a Mulatto from which the external layer of cuticle has been removed, showing the internal or coloured layer.

1869. A section of the skin of a Tawny person, with the external layer of cuticle turned down, and also a part of the internal layer, which is stained by the pigmental secretion.

1870. A section of the skin of a Negro, with a portion of the external and internal cuticles turned down; the latter, which is stained with the pigmentum, is described in the Manuscript Catalogue as 'the rete mucosum.'

1871. A similar preparation from a Negro, of a darker shade.

1872. Two portions of the cuticle of a Negro, one from the upper, the other from the lower surface of the foot; the former, which is thin and stained with the pigmentum, lies at the bottom of the bottle; the latter, which is very thick, and consists of many layers, is colourless, the pigmentum not being secreted at that part.

1873. A section of the nose and upper lip of a Swarthy person, showing a continuation of the pigmental secretion, together with the cuticle half an inch within the cavity of the nose.

1874. A section of the lips and cheek of a Negro, showing that the dark pigmentum is secreted beneath the cuticle lining the inside of those parts.

1875. A section of the anus of a Negro, showing the coloured cuticle continued for about one third of an inch within the rectum.

1876. A section of the skin of a Baboon, with the cuticle partially removed and reflected to show the blue or violet colour of the subjacent pigment.

1877. A section of the integument of a Hog (*Sus scrofa*, Linn.), including a patch of hair of a black colour, part of which has been removed, together with the cuticle, showing a deposition of a similarly coloured pigmentum in the corium from which the black hair grows.

1878. A section of the skin of a Hog, showing two patches of the black pigmentum, and smaller groups of black hair growing from those patches.

1879. Part of the skin of a Hog, to show the difference of colour of the cuticle when separated, and also the stained internal cuticle or rete mucosum.

1880. The head and neck of a Turkey (*Meleagris Gallopavo*, Linn.), showing

the peculiar bright red pigmentum secreted in different parts of the integument.

1881. A section of the skin of the leg of a Turkey-Cock, showing the deposition of the red pigmentum between the corium and cuticle: a great part of the latter has been removed, and a small portion of the pigmentum has been scraped off from the lower part of the preparation. As this secretion is here unmixed with a continuous layer of cuticle, the rete mucosum caunot be demonstrated as a distinct membrane.

1882. The fore foot of a Tortoise, with the scaly cuticle reflected, showing the pigmentum to be secreted along with it, where it covers the outer side of the leg, and communicating to it a brown colour: on the inner side of the leg the pigment is deposited in the usual situation upon the surface of the corium, leaving the cuticle comparatively unstained.

1883. The hind foot of the same Tortoise, similarly prepared, and showing the same circumstances.

1884. The anterior half of a Mackarel (*Scomber Scombrus*, Linn.), having a strip of the scales and cuticle removed from one side to show that the peculiar dark-coloured markings of the skin are produced by a deposition of the pigmentum in the substance of the corium itself, a small portion of which is detached from the subjacent muscles.

2. *Fish-scales.*

1885. Two sections of the skin of a Carp (*Cyprinus Carpio*, Linn.), showing the imbricated disposition and mode of attachment of the scales, which are rendered very conspicuous in the present species from their large size. The base of each scale is lodged in a fold of the corium, but lies loose and unattached there. A corresponding fold of the cuticle is reflected over the apex or posterior margin of the scale, and closely adheres to it, so that in removing the cuticle the scales are also detached from the corium adhering by their apices to the cuticle. They increase in size by a deposition of fresh layers to the inner surface of their periphery.

1886. A section of the skin of a Carp, with some of the large scales raised, and the cuticle detached from them.

1886 A. Three scales 'of the Jew-fish,' showing the extent of surface over which the silvery cuticle is reflected, and to which the scales adhere. The very large size of these scales demonstrates with great distinctness their mode of growth from a centre, by the addition of layers to the circumference, the extent of each addition being shown by the concentric lines.

Presented by Captain Sir Everard Home, Bart., R.N.

1887. A portion of the skin of a Wolf-fish (*Anarrhichas Lupus*, Linn.), showing the scales deposited beneath the dark-coloured cuticle in the form of small detached round plates.

3. *Bony Plates.*

1887 A. A section of the skin from the back of the neck of a Crocodile (*Crocodilus acutus*, Cuv.), showing the osseous plates which are secreted beneath the nuchal scales. A part of the epidermal covering is preserved of one of the smaller plates; the bony laminæ are also covered by the pigment. The pigmentum is deposited between the epiderm and the bony plate, and is removed from one half of the largest scutum to expose the osseous substance beneath. *Prepared by Mr. Owen.*

4. *Shell.*

1887 B. A specimen of Triton (*Triton rudis*, Broderip), showing the thick and rugous cuticle, or 'periostracum,' with which the shell is covered. A small part is scraped off from the lip of the shell to show the white calcareous substance beneath. *Presented by Hugh Cuming, Esq.*

Series III. Epiderm, or Cuticle.

A. *IN PLANTS.*

Subseries 1. *As an external covering.*

1888. A section of the bark of a Birch-tree, with part of the external or cuticular layer removed.

1889. A section of the branch of a Tree, showing the reproduction of the new cuticle beneath the old, which is in process of being cast off.

1890. A section of the branch of a Tree, showing two layers of the cuticle in process of separation.

1891. A portion of a branch of a Thorn, showing the influence of the sun's rays upon the cuticle, which has turned white on the side exposed to them.

1892. A Leaf, from both sides of which the cuticle has been removed.

1892 A. A Holly-leaf, with the cuticle reflected from both surfaces, but preserved entire. *Prepared by Mr. Clift.*

1892 B. A portion of the leaf of the Banyan Tree dissected by insects.
Presented by Sir Everard Home, Bart.

B. *IN ANIMALS.*

"This substance is used for the external coverings of a vast number of animals, and is the same substance in all, although under a great variety of forms, according to the different purposes for which it is intended; being in some a simple covering, in others serving for a covering and for defence from external accidents, in others adapted for warmth, in others again serving as a covering and for progressive motion, or for progressive motion and offence and defence, or for offence simply, or for defence simply."—*Hunterian manuscript Catalogue.*

Subseries 1. *Cuticle as an external covering.*

1893. The external epidermic covering of a Sipuncle (*Sipunculus phalloides*, Pall.). This substance has so slight a connexion with the subjacent integument, that in the dead animal it is often found separated wholly or in great part; and in this state the animal has been called *Sipunculus saccatus* on the supposition of its being a distinct species.

1894. The cuticle of the hand of a Child, or 'cheirotheca.'

1895. The cuticle of the foot of the same, or 'podatheca.' In both these pre-

parations the nails, being productions of the cuticle, have separated along with it.

1895 A. The cuticle of the sole and hallux of the Orang-utan (*Simia Satyrus*, LINN.), showing the thickness of the cuticle, and its distinct layers on the sole, and the absence of the nail on the hallux, or hinder thumb.

Presented by Mr. Owen.

1896. A portion of cuticle from the heel of the Human subject, showing its superior thickness as compared with that from the Orang-utan in relation to the erect progression of the Human species, and the greater pressure which the cuticle of the sole has consequently to sustain. When viewed at the edge, this cuticle has the appearance of having been deposited in fibres perpendicular to the surface of the sole; but this arises from the depressions which receive the villi of the cutis. The true direction of its component layers is horizontal, or parallel to the sole.

1897. A smaller portion of cuticle from the same part, in which some of the horizontal laminæ have been separated from one another, showing their mode of connexion with each other by the coadaptation of the furrows and ridges originally impressed upon each successive layer as it was formed and molded upon the cutis.

1897 A. A section of the skin of a Monkey (*Macacus Cynomolgus*, CUV.), showing the thickened epidermic callosities which cover and defend the tuberosities of the ischia. *Presented by Mr. Owen.*

1898. A small portion of the cuticle of an Elephant (*Elephas maximus*, LINN.), showing its irregular sinuous surface, corresponding to similar inequalities in the cutis.

1899. A small portion of the skin of an Armadillo (*Dasypus Peba*, DESM.), showing the regular transversely oblong elevations of the cutis. The cuticle has been turned down, showing its depressions, corresponding to those elevations which, when further produced from the surface, form scales, as in the Manis. See Nos. 1925, 1926.

1900. A portion of the skin of an Ostrich (*Struthio Camelus*, LINN.), with the

cuticle partially reflected, showing the corresponding inequalities of the opposed surfaces.

1901. A portion of cuticle from the lower part of the thigh of an Ostrich, showing the sinuosities of the cutis gradually assuming a reticulate disposition, and the cuticle in consequence subdivided into flat scales.

1902. A portion of skin from the under surface of the foot of an Ostrich, showing the long processes which are sent off from the cutis, and the thick cuticular sheaths which cover them.

1903. A similar preparation from the same Ostrich, showing the cuticular sheaths blended into a horny callous mass towards the end of the toe, where the pressure is greatest.

1904. A similar preparation, which has been injected, showing the large size of the vessels secreting the horny sheaths of the dermal processes, which, from the pressure and attrition they are subjected to, require to be rapidly renewed.

1905. A portion of cuticle removed from the same part, showing its internal reticulate surface formed by the orifices of the sheaths for the dermal processes, and the obliteration of those orifices where the cuticular processes are blended together by pressure.

1906. The cuticle covering the lower surface of the last joints of the outer toe of an Ostrich.

2. *Cuticle lining internal surfaces.*

1907. A section of the œsophagus of a Lion (*Felis Leo*, Linn.), with part of the parietes removed, to show the thin layer of cuticle or epithelium which lines its internal surface, part of which is turned down.

1908. The stomach of a Rat (*Mus Decumanus*, Linn.), injected, and the cuticular lining reflected from the cardiac portion of the cavity.

1908 a. A portion of the jejunum of the Labiated Bear (*Ursus labiatus*, Cuv.), showing the cuticle or epithelium which lines its internal surface.

Prepared by Mr. Owen.

1909. A portion of the cuticle from the first stomach of a Whale, showing it to be composed of several layers.

1910. A section of the thick cuticle from the gizzard of an Ostrich, showing its structure to be fibrous, the fibres being perpendicular to the surface, which sustains the pressure during the grinding of the food.

1911. A section of the gizzard of a Silk-fowl (*Gallus Morio*, Temm.), showing the callous thickened cuticle which lines that cavity.

1912. A transverse section of the gizzard of a Swan (*Cygnus Olor*, Brisson), taken through the thickest part of the digastric muscles, and showing the two layers of cuticle lining their flattened triturating surfaces. The superficial layer is evidently fibrous, and the fibres are nearly perpendicular to the surface of support, as is seen in external cuticles which are subject to great pressure.

1913. A section of the cuticle which lines the prepuce of the Horse (*Equus Caballus*, Linn.).

1914. A similar preparation.

1915. A similar preparation.

3. *Cuticle in the form of Scales.*

1916. A portion of skin from the neck of a Tortoise, showing the commencement of the scaly disposition of the cuticle at its continuation with the skin of the back.

1917. Cuticle covering the tail of a Tortoise, showing the termination of the scales at the root of the tail, which being, like the neck, an extremely flexible part, is covered in the rest of its extent by a merely wrinkled integument.

1918. A portion of the skin of a Scincus, showing its close-set and thick scales.

1919. A portion of the skin of an Iguana (*Iguana tuberculata*, Linn.), with part of the scaly cuticle turned down, showing that the scales here result from a deposition of horny matter upon the imbricated surface of the cutis,

and not, as in Fishes, from a distinct substance secreted between the cutis and cuticle.

1920. A portion of the scaly cuticle of an Iguana, showing it to be composed of two layers, the outermost being probably about to be cast.

1921. A portion of the scaly cuticle of the Rattle-snake (*Crotalus horridus*, Linn.).

1922. A section of the large imbricated scales or scuta which cover the abdomen of the Rattle-snake, and which being moved by appropriate cutaneous muscles, assist in progressive motion.

1922 a. A portion of the skin of the common Snake (*Coluber Natrix*, Linn.), minutely injected; the vessels unite so as to form regular series of lozenge-shaped spaces, the angles of union being opposite the centre of each scale. *Prepared by Mr. Clift.*

1923. A section of skin from the front part of the shank of an Ostrich, showing the series of large imbricated scales which protect that part.

1924. A similar preparation.

1925. A portion of the skin of a Manis (*Manis pentadactyla*, Linn.), showing its imbricated structure. The cuticle has been removed from the upper part of the preparation to show the large rhomboidal processes of the cutis, upon which the horny scales are moulded, and which also send off two or three scattered hairs from beneath the scales: on the opposite side of the preparation may be observed the thick panniculus carnosus which erects the scales, and at the same time draws the integument around the animal as a means of defence.

1926. A portion of the skin of a Manis, with a few of the horny scales removed. Two Ticks (*Acari*) may be observed to have insinuated themselves beneath one of the dermal processes.

1927. A portion of cuticle from the tail of a Beaver (*Castor Fiber*, Linn.). Upon the surface next the cutis it may be observed that small pointed processes project obliquely inwards from the elevated ridges, which pass into corresponding depressions of the cutis, and serve to strengthen the adhesion between the two parts.

1928. A similar preparation.

4. *Cuticle, in the form of Hair.*

"Hair is of two kinds respecting growth. One is that which grows continually, or has the power of growing continually if not allowed to grow to its whole extent, or when allowed to grow to its full extent, although it then becomes stationary, yet is capable of growing when cut.

"The second kind grows until it arrives at its full extent, and then cut, or not cut, it must be shed, and like feathers must be replaced by another growth. Most animals have both sorts; but Man, I believe, has only the first. The tail and mane of the Horse is of the first kind, while the hair which covers the body is of the second."

Hunterian manuscript Catalogue of Drawings.

a. Hair of continual growth.

1929. A section of the Human scalp, injected, showing on the cut margins the depth to which the root of the hair penetrates the scalp.

1930. A portion of integument from the axilla of the Human subject, showing the short curled hair which grows at puberty from that part.

1931. The skin of the lower part of the face of a Man, showing the hair forming the beard and whiskers.

1932. A section of the nose and upper lip of a Man, showing the short, crisp hair which grows from the inside of the nostril, and defends the entrance of that cavity.

1933. A section of the tail of a Horse, with the upper part of the skin cut obliquely to show the direction of the roots of the hair, and the depths to which they penetrate the corium.

1934. A section of a Horse's tail, with the skin cut obliquely all round, showing the same circumstances.

1935. A longitudinal section of the skin of a Horse's tail, showing the extent and direction of the roots of the hair within the corium.

1936. A similar preparation.

b. Hair of temporary growth.

1937. A section of the skin from the flank of a Horse (*Equus Caballus*, Linn.), including the point from which the hair proceeds in a spiral direction.

1938. A section of the growing antler of a Fallow-Deer (*Cervus Dama*, Linn.), covered by its vascular periosteum and soft integument, from which grows a very short and delicate hair, resembling fur, or the pile of velvet.

1939. Another section of the antler of the Fallow-Deer, showing the same circumstance.

1940. A similar preparation.

1941. The extremity of the growing antler of a Fallow-Deer, showing the same velvet-like integument.

1942. A portion of the skin of a Mole, from which grows a more abundant and longer soft and delicate hair, or fur.

1943. Smaller portions of the integument of a Mole, showing the hair of nearly equal lengths, and of one kind, marked alternately with white and brown.

1944. A section of the cuticle from the sole of the foot of a Dromedary (*Camelus Dromedarius*, Linn.), on the inside of which may be seen the roots of the hairs, arranged in groups of four or five, and showing the depth to which they penetrate the corium.

1945. A section of the corium of a Dromedary, showing the arrangement of the orifices of the canals which contain the roots of the hair.

1946. A similar preparation.

1947. A portion of the skin of a Monkey, which has hair of two kinds, but not so distinct from one another as in the succeeding preparations.

1948. A portion of the skin of a Mocock (*Lemur*, Geoff.), showing the two kinds of hair, namely, the soft fur, and the longer, coarser, and more scanty hair, very distinct.

1949. A section of the skin of a Quadruped, showing several hairs growing from each bulb, presenting a structure similar to down.

1950. A similar preparation.

1951. A portion of the skin of a Beaver, in which the fur is long and extremely fine: the coarser kind of hair is very scanty.

1952. A strip of the skin of the Gray Squirrel (*Sciurus cinereus*, Linn.), in which the coarser hair is more abundant, and of two colours.

1953. A portion of the skin of a young Seal (*Phoca vitulina*, Linn.), in which the fur is very short and close-set.

1954. A portion of the skin of a Racoon (*Procyon Lotor*, Cuv.), showing the two kinds of hair.

1955. A part of the skin of a Badger (*Meles Taxus*, Cuv.), in which the fur is very scanty, but the hair long and bristly.

1956. A section of the skin of an Elephant, showing the tubular processes of the cuticle which pass into the canals of the cutis containing the bulbs of the hair, and which form the sheaths of the bulbs: the hair is here of one kind, extremely short, and scanty.

1957. A part of the skin of a Hog (*Sus Scrofa*, Linn.), which is also covered with hair of one kind.

1958. A portion of the skin of a Hog, from the North of Scotland, where there is a species of fur or wool besides the bristles.

1959. A portion of skin of the same Hog, with the bristles removed from one part, showing the subjacent fur or wool.

1960. A section of the integument from the back of a Hog, showing the glandular bodies which surround the bulbs of the bristles at that part.

1961. A section of the skin from the belly of a Hog, showing the same structure.

1962. A Hog's bristle, with the pulp injected, and contained in the conical cavity at the base of the bristle.

1963. A Hog's bristle with the inverted process of the cuticle, which forms the internal theca of the root.

1964. A section of the skin from the back of a Hog, on one of the cut surfaces of which may be observed the canals in the corium, containing the roots

of the bristles, some of which have been extracted, leaving the conical pulps which formed them adhering to the bottom of the canal. Immediately below the preceding canals, may be seen a newly formed bristle, which has not yet made its appearance above the cuticle. *This preparation is figured* (*Plate* xliii. *figs.* 4 & 5.).

1965. A similar section from the back of a Hog. At one part the bristles are removed, showing the cavities in the corium in which they were lodged, and the formative pulps; in another part the roots of the bristles are longitudinally divided to show the pulps *in situ*.

1966. A section of the lip of a Tiger (*Felis Tigris*, Linn.), exposing the roots of the whiskers, and the canals of the corium in which they are lodged: on one side a whisker is extracted, and the pulp upon which it was formed is exposed, together with the continuation of the cuticle within the canal, forming the internal theca of the root of the whisker. In the canal containing the whisker next below this, the internal theca is removed from one side of the root of the whisker, showing the reflection forwards of the cuticle at the base of the pulp upon the whisker. The same parts, namely, the pulp, the internal and reflected theca, and the root of the whisker, are also shown on the opposite side.

1967. A section of the lip of a Tiger, in which the pulp, the socket, and the cuticular theca lining the cavity of the socket of one whisker are well shown.

1968. A section of the lip of a young Lion (*Felis Leo*, Linn.), minutely injected, showing the sockets of two whiskers, which are laid open, exposing the roots of those parts. The sockets are composed of an inward reflection of the cutis, forming the external theca, which is lined by a continuation of the cuticle, forming the internal theca, and which cuticle is afterwards reflected upon the root of the whisker. In the upper bristle the root is obliquely laid open, exposing the vascular pulp upon and by which it was formed; the large nerves are traced to the base of the sockets of the whiskers situated below the preceding.

1969. A section of the lip of the same Lion, in which all the parts concerned in the growth of the whisker are equally well displayed.

1970. Three whiskers from the lip of the Sea Lion (*Phoca jubata*, GMEL.), in two of which the internal theca is shown, in the third the external theca, with the socket of the whisker, and the nerve attached to the base of the socket.

1971. A section of the lip of the Sea Lion, in which the sockets of three whiskers are exposed, and the large nerves are dissected which pass to them.

1972. A section of the lip of the Sea Lion, with the sockets of several whiskers laid open, to show the pulpy substance between them and the external theca; in the uppermost this part is laid open, and the end of the whisker is cut obliquely so as to expose the pulp.

1973. A portion of the lip of a Walrus (*Trichechus Rosmarus*, LINN.), including the sockets of three whiskers: from one of these the thick whisker has been removed; a second is left entire, with the whisker *in situ*; in the third a longitudinal section has been removed from the socket and root of the whisker, exposing the pulp lodged in the conical cavity of the latter, the cuticular theca lining the socket, and the very delicate reflected layer, which is soon lost upon the substance of the whisker. The large nerves of these apparently rude organs of sensation are distinctly shown in this preparation.

1974. A section of the lip of a Walrus, containing several bristles, and showing distinctly the parts concerned in their formation.

1975. A small section of the skin of the tail of a Rhinoceros (*Rhinoceros Indicus*, CUV.), on one side of which the theca of a single bristle is laid open, showing its base gradually diminished to a point, in consequence of the absorption of the formative pulp, the growth of the bristle having been completed. On the opposite side the root of a bristle has been cut obliquely through, showing that its cavity has been filled up by the horny secretion of the pulp as this part gradually receded and became diminished in size; just as happens to the fang of a tooth when its growth is completed. In constantly growing teeth, as the incisors of the Beaver and the tusks of the Boar, the cavity of the fang containing the pulp remains widely open at its base, as do the cavities of the roots of the bristles of the Walrus and Lion, which in like manner are perpetually

renewed: and it may be observed, that though teeth and hair differ in their chemical composition, yet in their mode of formation and vital phænomena they closely resemble one another.

5. *Cuticle in the form of Quills.*

1976. A section of the skin of a Hedgehog (*Erinaceus Europæus*, Linn.), showing the quills and a small portion of the hair. On the cut edge of the skin may be seen the roots and sockets of the quills, extending to different depths from the surface, according to the period of their growth: the newly formed ones are lodged deep, and terminate in a broad basis, the pulp being large and active, and the cavity containing it of corresponding size: but as the growth of the quill proceeds, the reflected integument forming the socket contracts, and gradually draws the quill nearer to the surface; the pulp is at the same time progressively absorbed, and the base of the quill in consequence gradually decreases in size, so that it is at last seen to be attached to the surface of the skin by a very narrow neck, below which the remains of the socket and theca are seen in the form of a small bulb.

1977. A portion of the skin of a Hedgehog, with both hair and quills. In this and the preceding preparations the strong panniculus carnosus may be observed beneath the skin.

1978. A section of the skin of a Porcupine (*Hystrix cristatus*, Linn.), with the hair and quills: one of the latter has been dissected, to show the parts concerned in its formation; its socket is laid open, and the layer of cuticle continued into it, to form the internal theca of the quill, is seen passing to the base of the quill, to be there reflected upon its outer surface. The base of the quill is obliquely cut, to show the small fluted pulp upon which it grows, and which secretes the soft medullary part of the quill. The horny exterior part which fills the interstices of the pith is a secretion of the surrounding capsule. The transparency of the horny part of the quill permits the contained medulla to be seen through it. The processes of the horn which fit into the grooves of the pulp occasion the dark longitudinal lines and fluted appearance of the

quill. The peculiar mode of attachment of the pulp to the subcutaneous part is well shown in this dissection: it adheres to the exterior of a small hollow sac, which is situated immediately beneath it.

1979. A small portion of the skin of the same Porcupine. In this, as in the preceding preparation, it may be observed that the quills are placed deeper in the integument as their formation is less complete, and that they approach the surface and become contracted at the base when their growth is finished.

6. *Structure and Growth of Feathers.*

1980. A feather from the body of a Goose (*Anser palustris*, Briss.). It consists of the following parts, viz. the *quill*, the *shaft*, and the *vanes*. The lower extremity of the quill is perforated by an aperture called the 'lower umbilicus'; the upper extremity shows another aperture at the point of convergence of the two lateral vanes, which is termed the 'upper umbilicus'. The shaft or stem has an external convex and an internal concave surface: the external surface is slightly rounded, and is covered with a layer of smooth, firm, elastic horn; the internal surface is divided into two parts by a mesial longitudinal groove commencing from the upper umbilicus. The vanes proceed from the sides of the shaft, and constitute the essential part of the feather. Each vane is composed of *barbs* and *barbules*. The barbs are like smaller feathers, consisting of a central stem and lateral processes, which are the barbules. These are scanty and disunited at the lowest barbs, but beyond these they become short and close-set, and are locked together by a mechanism requiring microscopic demonstration. This interlocking commences at the root of the barbs, and is continued for an extent increasing in each succeeding barb until the whole vane assumes the compact structure of a true feather; the downy and disjoined barbs are confined to that part of the feather which is next the skin, and which requires this modification to preserve its temperature.

1981. A portion of the pinion of the Scarlet Ibis (*Ibis rubra*, Cuv.), showing the insertion of the quills in the integument, the imbricated disposition of the feathers, and the small proportion of the downy part of these where

their office has reference to locomotion rather than to the protection of the surface of the body.

1982. A portion of the skin of the embryo of a Goose (*Anser palustris*, Briss.) towards the close of incubation, showing the down-fascicles which form the first covering of the bird. These present at this period the appearance of simple elongated bristle-like processes, gradually tapering to a point; but they have a much more complicated structure, which is here concealed by the thin external *theca* in which the component filaments of the down-fascicles are inclosed.

1983. A single down-fascicle of the embryo of a Goose, removed from its sheath, to show the number of long and delicately fringed filaments of which it is composed; these are all attached to a common stem, and soon expand after hatching, when the thin external theca dries, cracks, and falls off.

1984. A similar specimen divided into two portions, with the sheath of the filaments hanging down.

1985. A similar specimen, showing the thickness of the common stem of the down-filaments.

1986. Two of the feathers of a Gosling, which succeed the down-fascicle. The barbs are long in proportion to the shaft, and the barbules disunited, so that the vane is not compact, but downy, and adapted exclusively for the preservation of the warmth of the young bird.

1987. A fasciculus of down-filaments from a Swan (*Cygnus Olor*, Briss.).

1988. A portion of the skin of a Swan, dried and plucked of its feathers, showing the plumage characteristic of the young bird retained for the purpose of warmth beneath the superadded compact feathers of the adult. At the upper part are seen the stems of the down-fascicles, which are left entire at the lower part.

1988 a. A section of the skin taken from the breast of a Gannet or Solan Goose (*Sula Bassana*, Briss.), showing the deep insertion of the quills of the body-feathers; and the attachment of the panniculus carnosus to them, by means of which they are erected and shaken. The down-barbs

at the base of each feather are very much elongated, and form a warm covering next the skin. *Presented by Mr. Clift.*

1989. A portion of the skin of a Goose taken during the period of the moult, showing two of the formative pulps, the growing feathers having been removed. A portion of the exterior fibrous layer of the capsule of the pulp is turned down, but the structure of these very complex organs is much obscured by the injecting material which stains the pulp and is diffused through its substance by extravasation.

1990. A portion of the skin from the wing of a Goose, showing the pulps or matrices of two quills injected.

The growth of the quills has been about half completed, and the part of the bulb subservient to their formation has been reduced to its component membranes, which form a succession of dry transparent unvascular cones; below these cones the bulb retains its pulpy texture: it exhibits at its outer side a groove, which was applied to the inferior or concave surface of the shaft; from the middle of the groove a ridge may be observed to rise and gradually to increase in width until it expands into and forms the base of the pulp; the ridge is lodged in the longitudinal fissure of the concave side of the shaft, and there deposits the pulpy substance which occupies the centre of the shaft.

The margins of the pulp at the sides of the ridge diminish as this part increases, and are gradually lost; they have a beautiful crenate edge, from which the cuticular matter of the vane is deposited between the septa of the exterior membrane, in order to be moulded into the appropriate forms of barbs and barbules.

1991. A portion of the shaft and barrel of a quill-feather removed from one of the preceding pulps. The vane of the feather has been nearly completed, and the sides of the concave surface of the shaft are converging towards the middle line, where they ultimately meet when the shaft is fully formed. The quill, which still remains for completion, is here seen widely open, its convex or exterior parietes alone being formed. The internal and external laminæ may be seen extending forwards and inclosing the newformed barbs and barbules. At the point where the feather has emerged

from its mould, the broken edges of these laminæ may be observed; the substance of which dries and crumbles away when the feather has passed through the skin, and has for a certain time been exposed to the influence of the atmosphere. A longitudinal moiety of the exterior theca has been removed to show the barbs already fully formed at the part where the stem is yet incomplete. A part of the thin cuticle which covers the horny theca is turned down from the latter on the opposite side of the shaft.

1992. A quill feather in progress of formation, suspended by its base, in which the barbs and shafts at the extremity are completed and have burst forth from the theca. The remainder of the barbs and shaft are in different stages of growth, becoming more soft and pulpy as they approach the base.

The material of which they are composed is deposited between two membranes which are situated between the bulb and the outer capsule or theca. The external membrane sends off from its inner surface a series of close-set parallel laminæ, extending obliquely from a longitudinal line corresponding to the back of the feather, to another longitudinal line at the opposite side, where they meet, but do not join. The barbs and barbules are moulded in the interspaces of these septa and thus surround the bulb; the whole is protected by the external capsule, which is strong in proportion as the parts contained are soft and tender. The pulp, or matrix, contained in the cavity thus formed by the nascent barbs and their formative membranes, has here been dislodged and is turned downwards, showing the long pyramidal ridge corresponding to the convexity of the shaft and which secretes the firm horny material of that part, and also the crenate or scolloped lateral fringes of the pulp which were lodged between the striated membranes at the interspace of the roots of the barbs. The gradual absorption of the pulp, as the feather is completed, is here well displayed, and the dry membranous cones to which it is ultimately reduced may be seen opposite that part of the feather the formation of which is completed. The exterior theca has been removed from one side of the feather.

1993. Six transverse sections of a Goose's feather at a corresponding period of

growth, suspended one above the other in the ratio of their completion. In the highest section the following parts may be observed to succeed each other from without inwards: first, the external capsule; second, the external striated membrane; third, the barbs and barbules, with the shaft, the section of which is semilunar, in consequence of the pulp and inner side remaining incomplete; fourthly, the vascular bulb and internal membrane, which fills up the cavity formed by the barbs and the incomplete shaft. As the pieces succeed each other, the capsule may be observed to grow stronger, the barbs more pulpy, the shaft less perfect, and the formative bulb proportionally larger.

1994. A quill-feather of a Goose in progress of formation, from which the whole of the external capsule has been removed, showing the oblique position and state of formation of the barbs and their oblique disposition around the bulb, the base of which may be seen, injected, projecting from the lower opening of the half-formed feather.

The red colour of the protruded barbs results from a stain of the injection, not from its having passed into vessels in their substance.

1995. A quill-feather of a Goose in a similar state of growth, in which the immature barbs are covered by the capsule, while those at the extremity of the feather, which are fully formed, are beginning to expand, in consequence of the desiccation and falling away of the capsule. A portion of the new-formed pulpy vane at the base of the feather has been removed, to expose the pulp covered by the internal striated membrane; and the vascular integument which surrounded the base of the feather has been inverted and turned down to show the connexion of the base of the bulb to the skin, and the reflection of a pellicle of cuticle from the skin upon the capsule.

1996. A quill-feather of a Goose in a similar stage of growth, showing the constriction at the base of the capsule where the bulb adheres to the corium, and the sheath of the vascular corium which surrounds the base of the growing feather reflected from it: the feather is suspended by this sheath.

1997. A portion of the pinion with three quill-feathers of a Goose, nearly com-

plete. The new-formed and still pulpy barbs are inclosed with their uniting stem in the external theca. The matrix of the projecting and completed part of the feather has been reduced to a series of membranous cones, which have dropped off as they were successively protruded with the feather. One of these cones is shown at the apex of the bulb of the feather, of which the vane has been cut off. A longitudinal section of the matrix and capsule of this feather has been removed: part of the capsule has been taken away from the adjoining feather, and it is left entire upon the third. The sheath formed around the base of the feather is removed from the external side of each, showing the depth to which the feathers are sunk into the skin.

1998. A portion of the skin of an Ostrich (*Struthio Camelus*), with three plumes, nearly completely formed, showing the extent to which the theca rises on each feather, before it crumbles away, to permit the expansion of the barbs, and also the extent to which the desiccated bulb rises with the feather before it begins to fall off. About an inch and a half of the base of each plume is invested by the external theca; the protruding bulb is reduced to a series of membranous cones packed upon one another. These cones successively escape and fall off until they become inclosed by the completion of the stem and the closing of the superior opening of the barrel.

1999. A single plume of an Ostrich, at the same stage of growth, from which a section of the theca and matrix has been removed to show the pulpy last-formed barbs, and the striated membranes between which they have been moulded. Portions of dark-coloured quill are placed between the external membrane and the barbs, and the internal membrane has been detached from a part of their inner surface. The gradual degeneration of the matrix as its functions become fulfilled, and the structure to which it is reduced before it is finally protruded and lost, are well shown in this specimen. The loose texture of the plumes of the Ostrich results from the want of connexion between the barbules of contiguous barbs, and they consequently present an approximation to the structure of down.

2000. The base of the quill-feather of a Goose, of which the whole of the stem

and part of the quill are completed. The tegumentary theca of the quill is left on one side, but has been removed, together with a longitudinal section of the barrel from the opposite side, showing the diminished vascular bulb occupying the base of the barrel. The structure of the bulb consists of white longitudinal fibres: the vessels and nerves enter this substance, which has been injected at the lower aperture of the quill. Its extremity is covered by a membranous cone, which, in consequence of the absorption of the pulpy substance, has fallen in, and a similar atrophy has left a series of hollow membranous cones in the rest of the completed quill. At the point opposite the superior aperture of the quill a filamentary process is continued from the apex of the nearest cone and passes through the aperture; a series of membranous cones are then continued into the hollow posterior part of the stem, where they are inclosed by the deposition of the pith and the completion of the anterior parietes of the stem at that part.

2001. The barrel of a Goose's quill-feather at near the completion of its growth, from one side of which a longitudinal section has been removed to show the last remnant of the bulb at the base of the quill, and the series of membranous cones extending from it through the quill to the stem, dividing at the superior umbilicus into the external and internal cones. A part of the external theca and skin remain attached to the base of the quill, the former being included in the base of the shaft, the latter passing out of the superior aperture of the barrel and falling away as the feather is protruded. The parts having been finely injected, show that the vessels penetrate no part of the feather except the bulb, and that this is the only medium of organical connexion between the body and the feather, which, like hair and teeth, is an extra-vascular product.

2002. A young Blackbird (*Merula vulgaris*, Cuv.), showing the down-fascicles which form its first plumage, here sparingly developed from the head, along the spine, and from each shoulder: the rudiments of the true feathers may be observed arranged in definite groups beneath the skin, upon the cranium, along the spine, upon each shoulder and hip, on each side of the chest and abdomen, and upon the wings, where they are of larger size and are destined to form the locomotive quill-feathers.

2003. A young Blackbird a few days older than the preceding, showing more distinctly the clumps of the feathers, the extremities of which have pierced the integument.

2004. A young Blackbird at a later period, showing the further development of the preceding clumps of feathers, and the appearance of additional clumps, as upon the carpus and metacarpus, and the legs.

2005. A similar specimen, showing the still more advanced stage of the growth of the feathers.

2006. A similar specimen, with the plumage further advanced. It may be observed that the parts most essential to life are first provided with their defensive covering; and that the feathers are not developed in those places where they would be subjected to habitual friction.

2007. A section of the integument covering the outside of one of the thighs of a Bittern (*Botaurus stellaris*, Cuv.), exhibiting an oval disc, on which the primitive downy condition of the plumage is preserved throughout life. The skin is thick, and has a more glandular appearance here than where the ordinary feathers are developed. The down-filaments are given off from the extremity of the quill in a penicillate form.

2008. A section of the skin from the breast of a Bittern, showing two oval patches of a similar series of down-feathers.

2009. The femoral down-clump of an East Indian Bittern (*Nycticorax*, Lath.), showing a similar structure of the skin and down-fascicles.

2010. The pectoral and femoral down-tufts of another Bittern (*Nycticorax*).

2011. A section of the skin taken from the wing of a Penguin (*Aptenodytes Patachonica*, Foster), showing the feathers arranged in regular oblique series. The wing being adapted as a fin for progressive motion in water, the feathers are very short, and from the great breadth of the shaft resemble elongated scales. They seem here to have been in progress of formation; the inferior umbilicus is widely open. The formative pulp and capsule not having completed their function: these have been removed in the specimen.

2011 A. A section of the skin of a Silk-fowl (*Gallus Morio*, TEMM.), showing the black colour of the skin, and the feathers arranged in curved rows, which diverge from a central line. *Presented by Mr. Clift.*

2011 B. The head and neck of a Golden Pheasant (*Phasianus pictus*, LINN.), showing the hackle feathers in progress of formation: many of them are protruded from the cuticular sheaths; and it may be observed that the barbs progressively increase in length as they rise further from the extremity of the feather, which is consequently expanded and straight, as if truncated. *Purchased.*

7. *Cuticle in the form of Nails.*

2012. The cuticle and nail removed from the extremity of a Human digit.

2013. A longitudinal section of the extremity of a Human finger minutely injected: the cuticle is turned down, showing its continuation with the nail; and on the cut surface may be seen the depth of the groove of the skin in which the gland and base of the nail are lodged.

2014. The thumb of a Man, injected, the cuticle turned down, and a portion of the cutis removed, to show the depth to which the base of the nail passes into the cutis.

8. *Cuticle in the form of Hoofs.*

2015. A longitudinal section of the foot of a Calf (*Pullus Vaccæ*), minutely injected, to show the thickness of the cuticle covering the extremity of the sole as compared with that which invests the circumference of the foot. The structure of the hoof thus formed is fibrous, the fibres being perpendicular to the plane by which the superincumbent pressure is transferred to the ground.

2016. The opposite section of the same foot.

It may be observed that in both these preparations a dense semi-transparent layer of horn is deposited in front of the last phalanx, resembling the nail in the Human species.

2017. One of the hoofs of a small Ox (*Bos Taurus*, LINN.).

2018. A longitudinal section of the hoof of a Cow, showing the dense structure

of its anterior and lateral parts, or wall; the great thickness and fibrous texture of its inferior part, or sole; the smoothness of the internal surface of this part, and the laminated internal surface of the wall, by which the hoof is fixed to the foot.

2019. A section of the hoof of a Cow, showing the inner surface of the sole, and the horny laminæ on the inner side of the walls of the hoof.

2020. Another section of the hoof of a Cow, showing the direction of the horny laminæ, and the denser substance which protects the anterior part of the last phalanx.

2021. The entire hoof of a Foal, showing its contracted base, or sole.

2022. Another hoof of the same Foal, with the part which corresponds to the sole removed, showing that it was a distinct substance.

2023. The hoof of a Foal, from which a longitudinal section has been removed, showing the dark-coloured, denser, horny portion which protects the anterior part of the last phalanx, and the great thickness of the cuticular deposits which form the sole or base of the hoof.

2024. The hoof of an Ass (*Equus Asinus*, Linn.). The part which defends the anterior and lateral surfaces of the last phalanx includes the walls, the coronet, and the quarters of the hoof. The thicker covering of the under surface of the foot is divided into the sole, which is the anterior concave part; the frog, which forms the posterior angular convexity; and the bars, which are the risings external to the frog. The horny laminæ in the interior of the hoof may be observed to be limited to the inner side of the walls and bars.

2025. A section of the extremity of the last phalanx and hoof of an Ass, injected, showing the mode of attachment of the hoof by means of the horny laminæ which project from its internal surface, as shown in the preceding preparation, and are received into the interstices of corresponding vascular laminæ, which project in an opposite direction from the glandular cutis covering the anterior and lateral parts of the last phalanx.

2025 a. A section of the hoof of the hind foot of an Elephant (*Elephas Indicus*, Cuv.), showing the division of the wall into three parts, corresponding to

the three digits: horny laminæ project from the internal surface of these divisions of the hoof for the purpose of effecting its attachment to the foot, as in the solidungulous Pachyderms. The cut surface shows the great thickness of the sole, and the perpendicular direction of the cuticular fibres which sustain the superincumbent pressure; a structure which is similar to that of articulating cartilage. *Prepared by Mr. Clift.*

2025 B. A smaller section of the hoof of the Elephant.

Prepared by Mr. Clift.

9. *Cuticle in the form of Claws.*

2026. The toe of a Lion (*Felis Leo*, Linn.), with the last phalanx in a relaxed or retracted state, showing the situation and form of the claw: it is concealed within a fold of the integument, part of which has been cut away in order to bring it into view. The cuticle covering the under surface of the last joint of the toe, which sustains the pressure in progressive motion, forms a thickened callosity.

2027. The last toe of a Lion, from which the skin and claw have been removed, showing the form of the last phalanx, for the firm lodgment of the claw: the parts are dissected so as to expose to view the elastic ligament passing from the second to the upper part of the last phalanx; also the second elastic ligament, which passes from the proximal end of the second phalanx to the under end of the base of the third, by the action of which ligaments the claw is retracted, and habitually maintained in that position; and lastly, the tendon of the 'flexor perforans,' which passes through a strong sheath behind the first phalanx, and over the convexity of the joint of the second, to be inserted into the prominence of the under part of the base of the third phalanx. It is by the action of the muscle to which this tendon belongs that the claw is extended and brought into play.

2028. The feet of a Wading Bird, showing the elongated claws at the extremity of the toes, and the horny callosity which terminates the prominence on the sole of the foot.

2029. The foot of a Bittern, showing the peculiar modification of the claw of the middle toe, the outer margin of which is provided with a series of small

processes slightly inclined towards the extremity of the claw, and resembling the teeth of a comb.

10. *Cuticle in the form of Spurs and Spines.*

2030. Part of the leg of a young Cock (*Gallus communis*, Temm.), from which a longitudinal section of the integument has been removed, showing the thickness of the cuticle covering the growing spur.

2031. A longitudinal section of the leg of a young Cock, showing the bone or phalanx which supports the spur; it commences by a separate ossification, which has not yet become anchylosed to the metatarsal bone.

2032. A section of the leg of an older Cock, showing the process of the metatarsal bone, which is developed opposite the phalanx of the spur, and the commencement of the anchylosis of the two parts.

2033. A section of the leg of an old Cock, showing the completion of the anchylosis of the phalanx of the spur to the metatarsal bone, and its thick cuticular covering, forming the spur. This part may be compared to the claws of the ordinary toes, and the bone which supports it to the last phalanx; and it is interesting to observe that the number of the phalanges progressively increases from the external to the internal toe, where they amount to five.

2034. The last joint of the wing of a Bird, showing a thick cuticular covering of the shortest phalanx, forming a spur or weapon of offence.

2035. A section of the integument from the back of the Iguana (*Iguana tuberculata*, Linn.), showing the long cuticular spines which project from the spinal ridge of that part.

2036. A section of the Piked Dog-fish (*Spinax Acanthias*, Linn.), including the dorsal fin, and the strong spine anterior to it.

2036 a. A section of the vertebral column of the same species, showing the long cartilaginous process which supports the horny dorsal spine, and the flattened cartilaginous processes before and behind it, to which the muscles are attached concerned in its erection and depression.

Prepared by Mr. Clift.

2037. The horny spine of the Dog-fish, and the cartilaginous process which supports it.

11. *Cuticle in the form of Horns.*

2038. A section of the cuticular part of the growing horn of a young Calf, removed from the bony protuberance of the os frontis, upon which it is supported, showing its relative thickness at different parts, and the hairs which surround its base.

12. *Cuticle in the form of Baleen, or Whalebone.*

2039. A section of the vascular gum and horny basis with parts of twelve baleen plates of the Piked-Whale (*Balæna Boops*, Linn.). (See the description of the structure and growth of this substance in the *Physiological Catalogue*, vol. i. p. 86. Nos. 319—323.)

13. *Cuticle in the form of Beaks.*

2040. The mouth of the Cuttle-fish (*Sepia officinalis*, Linn.), with part of the internal fringed lip removed to show the two horny jaws, which are shaped like the mandibles of a parrot, but with reversed proportions, the lowermost being the largest, having the hooked extremity, and overlapping the upper one when the mouth is closed.

2041. A section of the head and beak of a Calamary (*Loligo*, Cuv.), showing the two laminæ of the horny mandibles, and the fleshy substance on which they are supported. The horny covering and retroverted spines of the tongue are also shown in this preparation.

2042. The soft fibrous substance which supports the mandibles of the Cuttle-fish.

14. *Chitinous Tegument.*

2043. The two small pincers, or chelæ, which are situated above the mouth of the Scorpion (*Scorpio Africanus*, Linn.); they are considered by some entomologists to be modifications of antennæ, and are called Chelicers, or Horn-pincers.

2044. A Locust, showing the lateral mandibles and maxillæ, composed of the same dense and apparently horny substance as the chelicers of the Scorpion, and which is also extended over the whole surface of the body for its protection, and is developed upon the extremities in the form of spines and claws.

The two preceding preparations, which were placed by Mr. Hunter in the series of Cuticular parts, exhibit a material which differs, chemically, from cuticle or horn, and forms the external integument of all Insects; it owes its firmness of texture to a peculiar substance called Chitine, or Entomoline.

15. *Crustaceous Tegument.*

2045. A section of the crust or shell of an Echinoderm (*Echinus esculentus*, Linn.), showing the moveable calcareous spines with which it is armed, and which serve for both defence and locomotion.

2046. A Crustacean (*Galatea striata*, Leach), showing its calcareous covering, which is developed into immoveable defensive spines in several parts.

Subdivision XI.

PECULIARITIES.

"The parts peculiar to certain animals are all such as are not in general necessary, but relate to some peculiar circumstance in the economy of those animals, and therefore may be considered as parts superadded for particular purposes.

"We find many glands of this kind, of the use of which we are at present ignorant, in many cases; as in the head of the Elephant, in the Turtle, in certain Plants, &c. And also the gland with its excretory duct in the Snail for secreting slime is of this kind.

"The air-bladders in Fish, for diminishing their specific gravity.

"Light-coloured eyes in white animals *.

* These belong rather to accidental varieties than to the peculiarities of species.

"The various stings and weapons of defence in particular animals.

"Anal bags.

"Regeneration of parts seems also to belong here, since a very few animals* are endowed with that power; it is exemplified in the regeneration of the tail in the Lizard; in the casting of the skin in many animals; as also of the horny part of the stomach in Lobsters."

Hunterian manuscript Catalogue.

Series I.

A. *IN PLANTS.*

2047. A portion of the *Orobus tuberosus*, showing one of the tubercles connected with its root.

2048. Another section of the same plant, showing several similar tubercles developed upon the roots.

2049. A leaf of the Castor Oil plant (*Ricinus communis*), showing the glands of the footstalk at the base of the leaf.

2050. A section of the Alexandrian Laurel (*Ruscus hypoglossum*), showing the development of leaflets from the central stem of the leaves.

2051. A twig of a species of *Phillanthus*, showing the small flowers developed from the margin of the leaf.

2051 A. A portion of the wood and bark of the *Cercis Siliquastrum*, to show the flowers arising immediately from the wood.

Presented by Sir E. Home, Bart.

2051 B. A leaf of a species of *Saracenia*, showing its peculiar conformation for retaining a quantity of water or dew.

Presented by Sir E. Home, Bart.

2051 C. A leaf of the Pitcher Plant (*Nepenthes distillatoria*), showing the re-

* As this power is more or less enjoyed by all the cold-blooded classes of animals, and in a degree corresponding to the simplicity of their organization, it cannot be said to be limited to a very few animals.

ceptacle for containing fluid, which is developed from its apex.
Presented by Sir E. Home, Bart.

2051 D. A single flower of the *Corona imperialis*, to show the nectarium.
Presented by Sir E. Home, Bart.

2051 E. A similar specimen.
Presented by Sir E. Home, Bart.

B. *IN ANIMALS.*

Series II. Peculiarities of Bone.

2052. The skeleton of an Acanthopterygian Fish from the South Seas, preserved for the peculiar green colour of the bones.

2053. A bone of the head of the same Fish.

2054. The corresponding bone of the opposite side.

2055. The rays of one of the fins of the same Fish.

2055 A. The skeleton of the Gar-Pike (*Belone vulgaris*, Cuv.), to show the green tinge of the bones. *Presented by Mr. Clift.*

Series III. Peculiarities of Periosteum.

2056. The sternum of the Silk-Fowl (*Gallus Morio*, Temm.), showing the peculiar dark brown colour of the periosteum.

2056 A. The os hyoides of the same species of Fowl, showing the dark colour of the periosteum, and also of the membrane which covers the cartilages of the larynx. *Presented by Mr. Clift.*

2057. The muscles and bones of the left lower extremity of a Silk-Fowl, showing the dark-coloured periosteum and membrane covering the tendons and aponeuroses of the muscles. Portions of the periosteum are reflected from the subjacent bone, showing that the osseous substance is of the usual white colour.

Series IV. Peculiarities of the Vascular System.

Subseries 1. *Arteries.*

2058. A section of the rete mirabile, or arterial plexus which lines the intercostal spaces of the Piked Whale (*Balæna Boops*, Linn.). This structure is common to all the true or zoophagous Cetaceans.

Mr. Hunter, by whom it was discovered, gives the following account of it:

"Animals of the Whale tribe, as has been observed, have a greater proportion of blood than any other known, and there are many arteries apparently intended as reservoirs, where a large quantity of arterial blood seemed to be required in a part, and vascularity could not be the only object. Thus we find that the intercostal arteries divide into a vast number of branches, which run in a serpentine course between the pleuræ, ribs, and their muscles, making a thick substance somewhat similar to that formed by the spermatic artery in the Bull. Those vessels, everywhere lining the sides of the thorax, pass in between the ribs near their articulation, and also behind the ligamentous attachment of the ribs, and anastomose with each other. The medulla spinalis is surrounded with a network of arteries in the same manner, more especially where it comes out from the brain, where a thick substance is formed by their ramifications and convolutions; and these vessels most probably anastomose with those of the thorax.

"The subclavian artery in the Piked Whale before it passes over the first rib sends down into the chest arteries which assist in forming the plexus on the inside of the ribs: I am not certain but the internal mammary arteries contribute to form the anterior part of this plexus. The motion of the blood in such must be very slow; the use of which we do not readily see. The descending aorta sends off the intercostals, which are very large, and give branches to this plexus; and when it has reached the abdomen, it sends off, as in the quadruped, the different branches to the viscera and the lumbar arteries which are likewise very large for the sup-

ply of that vast mass of muscles which moves the tail."—*On Whales*, *Phil. Trans.* 1793.

2059. The kidney of an Ocelot (*Felis pardalis*, Linn.), injected, showing the peculiar arborescent disposition of the arteries upon its surface.

2059 a. The kidney of a Serval (*Felis Serval*, Schreb.), with the exterior arborescent arteries minutely injected with size and vermilion.

Prepared by Mr. Clift.

2. *Veins.*

2059 b. The kidney of a Seal (*Phoca vitulina*, Linn.), with the veins injected, showing their large size and peculiar reticulate or plexiform arrangement on the exterior of that gland. *Prepared by Mr. Owen.*

3. *Ganglions of the Vascular System.*

2059 c. A section of the spleen of the Basking Shark (*Selache maxima*, Cuv.).

Prepared by Mr. Clift.

2060. One of the branches of the aorta of a large Reptile, with the vascular ganglion adhering to it, of which a section has been made to show its cellular structure.

2061. One of the branches of the aorta of another large Reptile, with a similar body attached, of which several sections have been made, to show its compact or minutely cellular texture.

2062. A similar preparation.

2063. A section of the larynx of a Dromedary (*Camelus Dromedarius*, Linn.), with the thyroid gland attached, the two lobes of which are elongated and flattened, and connected at their lower extremities by a narrow flattened strip passing across the front of the trachea.

2064. A section of the trachea of an Elephant (*Elephas Indicus*, Cuv.), with the thyroid gland attached, the two lobes of which are of an oval form, and united by a slender filiform transverse strip.

2065. The suprarenal gland of an Elephant, longitudinally bisected, and the

lateral halves divaricated, to show the fibrous structure of the cortical part, and the homogeneous, pulpy, vascular nature of the intermediate substance, which has been partially injected.

Series V. Peculiarities of the Tegumentary and Cellular Systems.

2066. The cuticle of the Siponcle (*Sipunculus phalloides*, Pall.), showing its beautiful iridescent lustre.

2067. Two portions of an Earth-worm (*Lumbricus terrestris*, Linn), showing the shining iridescent lustre of the cuticle.

2068. A section of the integument of the Sea-mouse (*Aphrodita aculeata*, Linn.), showing the brilliant colours of the hairs.

2069. The Cape-Mole (*Chrysochloris aurea*, Cuv.), showing the similar brilliant lustre of its fur.

2069 a. A portion of the cuticle of the inside of the hind leg of an Indian Tortoise (*Testudo Indica*, Vosm.), showing some peculiar hard tubercles of a pearly lustre. *Presented by Sir Joseph Banks, Bart.*

2070. A section of the œsophagus of a Cuttle-fish, with part of the cuticular lining reflected, to show its peculiar dark colour.

2071. The head and neck of a Cock (*Phasianus Gallus*, Linn.), minutely injected, showing the tegumentary productions called the comb and wattles, and also the hackle-feathers, which characterize the male of this species.

2072. A section of the duplicature of the integument which forms the dewlap of the Brahmin Bull (*Bos Taurus*, var. *Indicus*, Linn.).

2073. A section of the back part of the neck of a Stallion (*Equus Caballus*, Linn.), showing the accumulation of ligamentous cellular and adipose tissue which supports the integument giving origin to the mane, and which is absorbed or is not developed in the castrated animal.

2074. A section of the tail of a Sheep from the Cape of Good Hope (*Ovis Aries*, var. *laticaudatus*, Linn.), to show one of the large lateral masses of fat

deposited beneath the caudal integument in this variety: the adipose accumulation is confined to the base of the tail, its extremity resembling the same in ordinary sheep.

2075. The other section of the same tail. The quantity of adipose substance accumulated in this part sometimes amounts to thirty or forty pounds in weight.

Series VI. Peculiar Organs of Adhesion.

2076. The fasciculus of silky hair-like filaments secreted by the gland at the base of the foot in the *Pinna fragilis*, and forming what is termed the 'byssus', by means of which this bivalve adheres to submarine rocks.

2077. The animal or soft parts of the Gigantic Clam (*Tridacna Gigas*, Lam.), showing its powerful byssus, and the strong muscular sheath surrounding the base of this organ of adhesion. The foot is of small size, but quite distinct from the byssus, and is grooved along its posterior surface, as in other byssiferous bivalves, for the molding of the fibres of the byssus, and their application to the substance to which they are destined to attach the animal.

2078. A posterior moiety of a Leech (*Hirudo medicinalis*, Linn.), showing the terminal disk, or sucker.

2079. A specimen of Distoma (*Distoma clavatum*, Rud.), to show the two suctorious discs or cavities: of these the anterior alone is subservient to the imbibition of nutriment, the posterior and larger sucker being merely an organ of adhesion. A longitudinal section has been carried through it and the body posterior to it, showing that it is separated by an investment of muscular fibres from the parenchyma beneath. The membranous sac which occupies the clavate extremity of the worm is well displayed, and a bristle is passed through its excretory outlet.

2079 a. The heads of two species of Tape-worm (*Bothriocephalus Pythonis*), showing the two deep suctorious cavities of which the head is composed, and by means of which the animal adheres to the mucous coat of the

snake's intestine, which it peculiarly infests. In one specimen the cavities or *bothria* are distended with mercury, in the other they are laid open. *Prepared by Mr. Owen.*

2079 B. A specimen of Tape-worm (*Tænia plicata*, RUDOLPHI) from the intestines of a Horse, with the head bent forwards to show the four suctorious cavities. *Presented by H. Earle, Esq. F.R.S.*

2080. One of the cephalic processes or arms of a Poulp (*Octopus vulgaris*, CUV.), showing the suckers or acetabula with which its inner surface is beset. These suckers are sessile in this species of Cephalopod, and consist of expanded circular disks formed by a duplicature of the integument, including radiating and circular muscular fibres: the inner surface of the disc is marked by lines, which converge to the margin of the central cavity; the bottom of this cavity is occupied by a muscular substance, which can be protruded and retracted like the piston of a syringe. When the Poulp applies the sucker to any object to which it is to attach itself, the piston is raised, and the cavity obliterated: it is then withdrawn, and a vacuum is produced, which can be further increased by a retraction of the central part of the disk itself, when the adhesion produced by the surrounding atmospheric pressure is so great, that in the living animal the arm may be torn off before the suckers will yield.

2081. A sucking Fish (*Echineis Remora*, LINN.), showing the suctorious disk, which occupies the upper surface of the head.

2081 A. The suctorious disk removed from the head of a larger species of Remora (*Echineis Naucrates*, LINN.). *Presented by Henry Salt, Esq.*

The disc is an oval flattened surface composed of a series of transverse laminæ directed backwards, and denticulated or spinous at their posterior margin: the laminæ are moveable, and, when recumbent, are in contact with each other; but when their spiny margins are raised and fixed in a foreign substance, a vacuum is produced in their interspaces, and the fish adheres firmly to the body to which the disc is attached, until it voluntarily retracts the circumference of the disc, destroys the vacuum, and depresses the laminæ, which then, from their peculiar arrangement, present little or no obstacle to the progress of the fish through the water.

Series VII. Peculiar Organs for Prehension.

2082. A section of the proboscis of an Elephant (*Elephas Indicus*, Cuv.), showing its ligamentous and muscular structure, and the two nasal passages.

2083. A similar preparation.

The nasal passages may be observed to be not in the centre of the trunk, but nearer the anterior surface: the muscles before them pass in a radiating direction to the circumference of the proboscis; those which are immediately behind the nasal passages are disposed in a straight line from side to side; external and posterior to these again the muscular fibres resume the radiated course. The second series of muscles tend to diminish, but cannot close the areæ of the nasal passages; the first and third series contract the diameter of the trunk without affecting that of the canals. All the muscles are distinct, and terminate at both extremities in slender tendons: they are imbedded in a cellular texture uniformly occupied by a white homogeneous adipose substance.

2084. A transverse section of an Elephant's proboscis, with the nasal passages laid open longitudinally, showing their smooth internal surface and cuticular lining.

2084 a. The end of a proboscis of a young Elephant, showing the digital process at that part. *Purchased.*

2084 b. The head and anterior extremities of a Chameleon (*Chamæleo planiceps*, Merr.), with the mouth laid open on one side, to show the tongue retracted, and especially its enlarged bifid prehensile extremity. The gular pouch at the base of the tongue is also displayed, and is partially distended with mercury. *Presented by R. B. Walker, Esq.*

Series VIII. Air-Bladders.

2085. The air-bladder of the Portuguese Man of War (*Physalia pelagica*, Lam.). A bristle is inserted into an orifice at one end.

2086. A similar preparation laid open longitudinally, to show the cavity of the air-bladder.

2087. A similar preparation, showing the numerous small laminæ which pass across the upper part of the air-bladder, opposite the base of the crest: bristles are inserted into two orifices leading to the sac.

2088. A small Gold-fish (*Cyprinus auratus*, Linn.), with the parietes of the abdomen removed, to show the air-bladder, which is divided by a middle constriction into an anterior and a posterior sac.

2089. A deformed specimen of the same species, with the parietes of the abdomen removed, exposing the air-bladder, the anterior division of which is much distended, and the posterior proportionally contracted.

2090. A similar specimen, with the lateral parietes of the abdomen removed, showing the relative position of the double air-bladder to the other abdominal viscera. In consequence of the greater weight of the muscular and osseous parts above the bladder, these sink when the fish has lost the power of balancing itself in the water, and the body then floats by means of the air-bladder, with the belly upwards.

2091. The anterior part of a Fish, showing the air-bladder *in situ*. It is laid open, and the transparent lining membrane is reflected from the proper tunic, which has a peculiar silvery lustre.

2092. A portion of the air-bladder of the Conger Eel (*Conger vulgaris*, Cuv.), minutely injected, to show the vascularity of the gland connected with it, and which is supposed to supply the loss of the gas which escapes by the duct leading from the bladder to the œsophagus.

2092 a. The double air-bladder of a Carp (*Cyprinus Carpio*, Linn.), with the vertebræ and ribs surrounding it, showing the bony processes from the

under part of the anterior vertebræ, to which it is attached, and which establish a communication between the air-bladder and the organ of hearing. *Mus. Langstaff.*

2093. A Tetrodon or Crop-fish (*Tetraodon lagocephalus*, Bloch), to show the air-bag developed from the œsophagus in the distended state, laid open, and a bristle placed between the two orifices, by which it communicates with that tube.

The distension of this capacious sac is effected in the living animal by swallowing air; and when the body is thus, as it were, blown up, the position of the fish becomes reversed, and it floats with the belly uppermost, incapable of directing its course. In this state, when it might be supposed to fall an easy prey to its enemies, it is, on the contrary, best defended from their attacks, the spines with which the skin is armed being then erected, and made to project in every direction.

2094. A small Crop-fish, with the œsophageal air-bag undistended laid open.

2095. A large specimen of Pennant's Globe-fish (*Tetrodon Pennantii*, Yarrell), with the œsophageal sac laid open, so as to expose the orifices leading to and from it. A quill is inserted into that which leads to the second œsophagus and stomach.

Series IX. Peculiar Organs of Secretion.

Subseries 1. *Glands opening upon the Head.*

2096. A section of the skin of the side of the face of the male ring-horned Antelope (*Antilope Cervicapra*, Pall.), including the large suborbital sinus: this consists of an internal fold or pouch of integument, the bottom of which is occupied by a series of large sebaceous or mucous glands, in the intervals of which there are a few short scattered hairs. The circumference of the pouch, which is next the bones of the head, is entire and imperforate, and covered with a stratum of muscular fibres, by which it

can be protruded and partially everted, and the glandular and secreting surface can thus be brought into contact with, and rubbed against, foreign bodies.

2097. A section of the suborbital sinus and contiguous integument of the same species of Antelope.

2098. The other portion of the same sinus.

These preparations demonstrate the thickness and complex structure of the sebaceous glands of which the walls of the sinus are principally composed.

2099. A section of the skin of the face of another species of Antelope, including the suborbital sinus.

2100. The opposite suborbital sinus of the same Antelope, laid open so as to show the large orifices by which the sebaceous secretion passes into the sinus.

2101. A section of the skin of the face of the Reindeer (*Cervus Tarandus*, Linn.), including the suborbital sinus. This is relatively smaller than in the Antelope.

2102. A similar section of a female Antelope, including the suborbital sinus, which is of small size in that sex.

2103. The scent-gland from the side of the head of an Elephant, the duct of which opens at a short distance behind the eye. The gland is of a flattened and lobulated form: a section has been removed from one side to show its thickness and compact structure. It is stated to be in activity and to secrete an unctuous fluid having a strong musky odour at the period of sexual excitement.

2104. The tongue and adjacent parts of an Alligator (*Crocodilus Lucius*, Cuv.), including the two sublingual musk glands and their muscles. These glands open each upon the inner surface of a small sinus formed by an inward reflection of the integument, situated below the mouth and near the rami of the lower jaw. The muscle destined for the compression of the sinus and the expulsion of its contents is detached from the poste-

rior part of the pharynx, and proceeds along the outer side of the hyoid apparatus, to expand upon and surround the glandular cavity*.

2105. A section of the lower jaw and tongue of a Turtle (*Chelonia Mydas*, Brongn.), showing one of the corresponding subcutaneous scent-glands. A bristle is placed in its duct, which opens about an inch and a half behind the symphysis of the jaw, and about half an inch from the mesial line.

2106. The cuticle removed from the side of the head of a large Rattle-snake (*Crotalus horridus*, Linn.), showing the sacculi reflected inwards to line two suborbital sinuses, in one of which a bristle is placed. This preparation is figured by Sir Everard Home in the *Philosophical Transactions*, 1804, Plate III. fig. 3. p. 76, where the following account of it is given.

"The orifices situated between the eye and the nostril in the Rattle-snake, and in some species of *Coluber*, do not lead to the nostril or to the ear, but to a distinct bag of a rounded form: there is a hollow of the same shape surrounded by bone, and adapted to receive it. Dr. Tyson's description of the rattle-snake is tolerably accurate: he says, 'Between the nostrils and the eyes, but somewhat lower, were two orifices, which I took for the ears; but after, I found they only led into a bone, that had a pretty large cavity, but no perforation.†'

"The cavity which Dr. Tyson describes to be in the bone, is a cup, formed by the bones of the skull and those of the upper jaw; it is in shape not unlike the orbit, and is formed in a similar manner.

"These bags bear a relative proportion to the size of the snake; they are lined, as also the eyelids, with a cuticle, which forms the transparent cornea, making a part of the outer cuticle, and is shed with it; and, when examined after the snake has cast it off, their shape is more perfectly seen than under any other circumstances.

"In the Deer and Antelope there are bags, in the same relative situation respecting the eye and the nose, resting upon the skull; there is also

* See Mr. T. Bell's excellent description and figure of this structure in the *Philosophical Transactions*, 1827, p. 132.

† *Philosophical Transactions*, vol. xiii. p. 26.

a cavity in the bone, adapted to receive them. The bags vary in size in the different species of these genera. The French naturalists have given the name of *larmiers* to these bags, conceiving them to be receptacles for the tears, of which the thinner parts evaporating, a substance remains called *larmes de cerf*.

"I requested my friend Mr. André to examine these bags in the common Buck, and to observe their relative position to the puncta lachrymalia; his situation in the Earl of Egremont's family at Petworth affording him every opportunity for doing it. He informs me that the bags are lined with a cuticle, similar to that of the meatus auditorius externus in the Human ear: their internal surface is smooth, free from hair, and without any appearance of glandular structure. From the inner angle of the eye to this bag there is a kind of gutter in the skin, of a darker colour than the rest of the skin in light-coloured animals, and the hairs are shorter than on the rest of the body. The substance contained in the bags resembled that found in the ears.

"The lachrymal gland in the Deer, he says, is very large, and the puncta so much so as to admit the rounded end of a common probe. There is no lachrymal sac: the tubes from the puncta unite, and pass through a small opening in the bone to the nose.

"The following account of these bags in the Antelope of Sumatra was transmitted to me in the year 1792 by Mr. William Bell. 'The external orifice is of the size of a crow-quill; it leads into a bag not larger than a small marble, which is lined with a cuticle, with hair. From this bag there is a secretion of a limpid fluid, which keeps oozing down the nose.' This gentleman, unfortunately for natural history, died at Sumatra soon after the date of his letter.

"In the Hunterian Museum, intrusted by Government to the care of the College of Surgeons, there are several specimens of these bags from the Indian Antelope with annulated horns, and also from some other species: these are preserved so as to show the internal cavity of the bag, and the structure of the gland immediately behind it. In these specimens the glandular parts is a quarter of an inch in thickness: from the centre of this gland an excretory duct opens into the bag, immediately

opposite to the external orifice *. The bag itself is lined with a cuticle, and thinly set with strong hairs.

"The facts now produced are sufficient to prove that these bags have a secretion of their own, the quantity of which varies according to the climate and other circumstances; and there is no reason for thinking that the tears ever pass into them, the passage into the nose being unusually free, and the orifices in the bags, in many species, unfavourably situated for the reception of the tears.

"We are at present unacquainted with the use to which the fluid secreted in these bags is applied.

"As amphibious animals, in general, have no glands to supply the skin with moisture from within, but receive it by coming in contact with moist substances, it is possible the bags, in the Snake, may be supplied in that manner, and the more so as the cuticular lining appears perfect.

"Another peculiarity is remarkable in Snakes furnished with the bags described above, namely, an oval cavity situated between the bag and the eye, the opening into which is within the inner angle of the eyelid, and directed towards the cornea. In this opening there are two rows of projections, which appear to form an orifice capable of dilatation and contraction."—*Home, Philosophical Transactions, vol.* xciv. *p.* 72.

Subseries 2. *Glands opening at the sides.*

2107. A young Trout (*Salmo Fario*, Linn.), showing the lateral line formed by a row of muciparous glands, extending from the head to the tail, the ducts of which penetrate the superjacent scales. In this instance the mucus seems to have been poured out in preternatural abundance.

2108. A section of the skin of a Siren (*Siren lacertina*, Linn.), including a portion of the elongated group of muciparous glands, which are minutely injected.

2109. Sections of the integument of a Musk Shrew (*Sorex Myosurus*, Pallas), including the two lateral groups of glandular follicles, which secrete the

* In the preparations above alluded to it will be seen that the follicles composing the glandular substance are numerous, and open by many distinct orifices.

odorous substance characteristic of this species; one of the glands is left entire, the other is bisected.

3. *Glands opening upon the back.*

2110. A section of the skin of the back of a Peccary (*Dicotyles torquatus*, Cuv.), including the scent gland, the excretory duct of which opens upon that part, and near the root of the tail.

4. *Glands opening above the tail.*

2111. The os coccygis of a Gander (*Anser palustris*, Briss.), showing the coccygeal gland upon its upper surface; it is bilobed, and each lobe is of a depressed pyriform shape; their apices converge backwards, and are perforated by a circular series of excretory orifices, from which the unctuous secretion may be seen to be protruded, and adhering to the small feathers which grow, like a brush, from that part.

2112. The os coccygis, with the coccygeal gland entire, of the Black Swan (*Cygnus atratus*, Meyer).

5. *Glands opening upon the groin.*

2113. A section of the skin of the groin of the Corinne Antelope (*Antilope Corinna*, Gmel.), including the two nipples, and the large inguinal glandular pouches, which are situated external to them.

6. *Glands opening within the prepuce.*

2114. The musk-bag, or glandular preputial sinus of the Musk Deer (*Moschus moschiferus*, Linn.) bisected, including a portion of the surrounding integuments and the nipples, to show their relative position. (This preparation appears to have been made from a dried specimen.)

2115. A section of the skin of the groin and anterior part of the prepuce, including the musk gland and cavity, of the Musk Deer.

2116. The lining membrane of the preputial musk-bag of the Musk Deer.

2116 a. A section of the skin of the groin, including the musk gland and preputial canal and nipples of the Musk Deer. A thick bristle is passed

through the prepuce. This preparation has been put into spirits in the recent state, and shows the true thickness of the gland.

Presented by Robert Home, Esq.

2117. A portion of the dried musk bag, with its secretion, or the musk of commerce.

2118. A section of the integument of the Beaver (*Castor Fiber*, Linn.), including the cloacal aperture, with the preputial and anal glands, and part of the rectum. The penis of this animal is bent backwards, so that the prepuce opens with the rectum immediately within the common outlet; the large preputial follicles which secrete the castor of commerce are two in number, and communicate together at their termination in the prepuce. They are here laid open, showing the irregular rugæ and cuticular lining of their internal surface. The anal bags are of an elongated form, but have a smaller diameter than the preputial ones, behind which they are situated, and to which they are connected by a common investment of muscular fibres, subservient to the expulsion of their respective secretions. A bristle is passed into the orifices of the anal bags, of which the one on the left side is laid open, showing its smooth internal surface.

2119. The preputial follicle or castor-bag of a large Beaver, laid open to show its irregular glandular internal surface.

2120. A section, including the rectum, vagina, and part of the uterus, the urinary bladder, urethra, and preputial gland of the female Beaver: the gland is a capacious bag, but of smaller size than the corresponding part in the male: it has a similarly corrugated internal surface, and is lined with cuticle. A bristle is placed in its excretory orifice, which communicates with the urethra about half an inch from the extremity of that passage.

2121. A small bottle containing the secretion of the preputial follicles of the Beaver.

2122. Dried portions of the same secretion, which forms the 'castoreum' of the materia medica.

7. *Glands opening at the anus.*

2123. The rectum of the Blue-bottle, or Flesh Fly (*Musca carnaria*, Linn.), showing four glandular bodies attached to the coats of that intestine. For a description of these parts, see *Physiological Catalogue*, vol. i. page 189.

2124. The soft parts of a Snail (*Helix Pomatia*, Linn.), with the respiratory cavity laid open to expose the slime gland, the duct of which opens near the anus, and is here shown filled with injection.

2124 a. A bottle containing some of the peculiar coloured secretion of a gland similarly situated in the Purple (*Purpura patula*, Lam.), supposed to have been the basis of the celebrated Tyrian die or purple of the Ancients.

Presented by Hugh Cuming, Esq.

2125. The alimentary canal and ink-bag of a Calamary (*Loligo*, Cuv.); the ink-bag is of an elongated form, and is suspended anterior to the rectum, with which it communicates near its termination. It is laid open to show the thick cellular and glandular parietes which secrete the inky fluid.

2126. The ink-bag and termination of the intestine of a Cuttle-fish (*Sepia officinalis*, Linn.).

2127. A Sepiola (*Sepiola vulgaris*, Leach) laid open to show the ink-bag *in situ*. It is situated on the ventral and anterior part of the visceral cavity, and consists of two oblong lateral pouches, connected by a shorter middle division; the glandular parts of the bag form the anterior parietes of the lateral pouches, and may be distinguished by their light colour and opacity from the thinner tunics of the remainder of the ink-bag, which permit the black colour of its contents to appear through. The ink-bag of another specimen is displayed above the one dissected.

2128. The rectum of a Shark, showing the glandular bag which communicates with it, and which is laid open to show its thick cellular parietes.

2129. The termination of the intestine and the anal glandular pouch of a Dog-fish (*Spinax Acanthias*, Cuv.); both parts are laid open, showing the spiral valve in the gut and the thick compact glandular parietes of the

pouch, and have been injected to show the vascularity of the secreting surfaces.

2130. A section of the skin of a Turtle, to show a gland situated near its anus.

2131. The termination of the rectum, with the cloaca and anal bag, or 'Bursa Fabricii', of a Heron (*Ardea cinerea*, Linn.); the anal bag is of an oval form; it is laid open to show the thickness of its glandular parietes, and the large orifices of the numerous follicles of which it is composed; the bag communicates with the cloaca behind the rectum: a bristle is inserted at the excretory orifice, by which the secretion escapes.

2132. The termination of the rectum, with the anal bags and surrounding integuments, of an Armadillo (*Dasypus novem-cinctus*, Linn.); the bags are of a globular form, about eight lines in diameter, with thin parietes, and terminate by wide apertures close to the sides of the anus.

2133. A section of the perineum of the Manis (*Manis pentadactyla*, Linn.), including the termination of the rectum and prepuce, and one of the anal glands. This is laid open from behind to show the rounded glands with which its inner surface is beset. A bristle is inserted into the common excretory duct.

2134. The opposite gland of the same Manis, laid open from behind to show the internal follicles, each of which pours its secretion into the common cavity by a single and central aperture.

2135. The termination of the rectum and urethra, with the surrounding integument, of a Hare (*Lepus timidus*, Linn.). The parts have been injected; a white bristle is placed in the rectum, a black one through the urethra and prepuce, which is close to the anus, leaving a very narrow space for the perineum: a deep glandular fossa occupies the lateral interspace between the rectum and prepuce on each side; it is seen entire on the right side, on the left it has been laid open together with the prepuce.

2136. The termination of the rectum, with the anus and anal glands, of a Quadruped; bristles are inserted in the excretory orifices of the glands, one of which is dissected to show its very small size.

2137. The anal bag of a Quadruped; it is of a spherical form, and about half

an inch in diameter, and is laid open to show the thinness of its parietes, and smooth internal surface. A bristle is passed through its duct, which terminates upon a small mammillary eminence.

2138. A section of the integument of the perineum, with the opposite anal gland *in situ*, of the same Quadruped. A bristle is inserted in its duct.

2139. The termination of the rectum of the Spotted Cavy (*Cœlogenys subfusca*, F. Cuv.), laid open to show the excretory outlets of the anal bags.

2140. The termination of the rectum and one of the anal bags of the Ferret (*Putorius Furo*, Cuv.); the bag is laid open, and a bristle passed through its excretory duct.

2141. The termination of the rectum and anal glands of the Zorille (*Putorius Zorilla*, Cuv.); both glands are laid open, showing on one side the thick cuticle lining the cavity, and on the opposite side the glandular substance surrounding the duct, through which a bristle is passed: the cuticular lining of this cavity has been removed entire, and lies at the bottom of the bottle.

2142. The anus and one of the anal bags of a Martin Cat (*Mustela Martes*, Cuv.); the bag is laid open to show the large glandular follicles which open into it, and its thick cuticular lining, which is reflected from the subjacent membrane.

2143. The rectum, with both the anal bags and surrounding integument of the Javanese Skunk (*Mydaus meliceps*, Horsfield); the gut is laid open to show the mammillary prominences within the verge of the anus, upon which the ducts of the anal bags terminate; one of the bags is left entire, surrounded by its muscular covering; the other is laid open, showing the relative thickness of its muscular and glandular coats.

2144. The secretion of the glandular follicles of a Skunk.

2145. The anal gland of an Otter (*Lutra vulgaris*, Cuv.) laid open, showing the cellular structure of its thick glandular parietes, and the large scattered orifices by which the secretion passes into the cavity of the bag.

2146. The anus, vulvæ, and surrounding integument, with part of the rectum and vagina, and the anal glands of a Wolverine (*Gulo Luscus*, Cuv.);

one of the glands is entire, and surrounded by its muscular covering; a section has been removed from the opposite bag, showing the thickness of the glandular substance from which the duct commences, and through which a bristle is placed.

2147. The termination of the rectum, with the anus and anal glands, of a Tiger (*Felis Tigris*, Linn.). These are of large size; they have a common exterior muscular investment, and communicate together before their termination, which is by a wide aperture immediately above the anus.

2148. The corresponding parts of a Hyæna (*Hyæna striata*, Linn.), showing the large anal glands. These are four in number, placed symmetrically two on each side and above the termination of the rectum; on the right side they are left entire, to show their external form; on the left side they are laid open, showing the thick parietes of the smaller and superior gland, and the small apertures by which they communicate with the wide transverse sinus, which is situated above the anus, and is common to all the four glands.

2149. A section of the corresponding parts of another Hyæna, showing the exterior of one of the anal glands, and the relative positions of its excretory outlet, the anus, and vulva.

2150. The opposite section of the same parts, in which a part of the glandular parietes has been removed from the inferior anal gland, showing the thick secretion which fills its cavity.

2151. The section removed from the anal gland shown in the preceding preparation.

8. *Glands opening between the toes.*

2152. A foot of a Deer (*Cervus Dama*, Linn.), showing the orifice leading to the glandular follicle between the toes.

2152 a. The hind foot of a Reindeer (*Cervus Tarandus*, Linn.), with the cuticle stripped off, showing the fold of the integument within which is the opening of the lubricating gland of the hoofs.

Presented by William Bullock, Esq. F.L.S.

2152 B. A section of the foot of a Sheep (*Ovis Aries*, Linn.), with the skin dissected from the inner side of one of the toes, to show the lubricating gland *in situ*. It is of an elongated form, and bent forwards at an acute angle upon its excretory duct. *Prepared by William Clift, Esq. F.R.S.*

9. *Peculiar Secretions.*

2153. A portion of silk spun by the larva of 'an East Indian species of Moth', —(*MS. Catal.*)

2154. Scales of wax taken from the under surface of the abdomen of a Bee.

2155. A mass of Bees' wax.

Of this secretion Mr. Hunter gives the following account:

"The wax is formed by the Bees themselves; it may be called an external secretion of oil, and I have found that it is formed between each scale of the under side of the belly. When I first observed this substance, in my examination of the Working Bee, I was at a loss to say what it was: I asked myself if it was new scales forming, and whether they cast the old, as the Lobster, &c. does? But it was to be found only between the scales, on the lower side of the belly. On examining the Bees through glass hives, while they were climbing up the glass, I could see that most of them had this substance, for it looked as if the lower, or posterior edge of the scale, was double, or that there were double scales; but I perceived it was loose, not attached. Finding that the substance brought in on their legs was farina, intended, as appeared from every circumstance, to be the food of the maggot, and not to make wax; and not having yet perceived anything that could give me the least idea of wax; I conceived these scales might be it, at least I thought it necessary to investigate them. I therefore took several on the point of a needle, and held them to a candle, where they melted, and immediately formed themselves into a round globe; upon which I no longer doubted but this was the wax, which opinion was confirmed to me by not finding those scales but in the building season. In the bottom of the hive we see a good many of the scales lying loose, some pretty perfect, others in pieces. I have endeavoured to detect them either taking this matter out of themselves,

from between the scales of the abdomen, or from one another, but never could satisfy myself in this respect: however, I once caught a bee examining between the scales of the belly of another, but I could not find that it took anything from between. We very often see some of the bees wagging their belly, as if tickled, running round, and to and fro, for only a little way, followed by one or two other bees, as if examining them. I conceived they were probably shaking out the scales of wax, and that the others were ready upon the watch to catch them, but I could not absolutely determine what they did. It is with these scales that they form the cells called the comb; but perhaps not entirely, for I believe they mix farina with it; however, this only occasionally, when probably the secretion is not in great plenty. I have some reason to think that where no other substance is introduced, the thickness of the scale is the same with that of the sides of the comb; if so, then a comb may be no more than a number of these united; but a great deal of the comb seems to be too thick for this, and indeed would appear to be a mixture, similar to the covering of the chrysalis. The wax naturally is white, but when melted from the comb at large it is yellow. I apprehend this might arise from its being stained with honey, the excrement of the maggots, and with the bee-bread. I steeped some white comb in honey, boiled some with farina, as also with old comb, but I could not say that it was made yellower. Wax, by bleaching, is brought back to its natural colour, which is also a proof that its colour is derived from some admixture. I have reason to believe that they take the old comb when either broken down, or by any accident rendered useless, and employ it again; but this can only be with combs that have had no bees hatched in them, for the wax cannot be separated from the silk afterwards. Reaumur supposed that they new-worked up the old materials, because he found the covering of the chrysalis of a yellower colour than the other parts of the new comb; but this is always so, whether they have old yellow comb to work up or not, as will be shown.

"The Bees which gather the farina also form the wax, for I found it between their scales."

Observations on Bees, Phil. Trans., vol. lxxxii. p. 145.

2155 A. A bottle containing some 'artificial wax obtained from animal oil' by the Donor. *Professor Brande, F.R.S.*

10. *Poison Glands.*

2156. The sting, poison-bag, and glands of a Wasp (*Vespa vulgaris*, FABR.). The secreting organs of the irritating fluid consist, like all the other glands of Insects, of filamentary tubes, which are two in number, and are here unravelled. They communicate together before terminating in the poison receptacle, and a slender duct conveys the secretion from the receptacle to the base of the sting, along the cavity of which the duct is continued to within a short distance of the extremity, where it terminates by a narrow oblong opening.

2157. A female Humble Bee (*Bombus terrestris*, LATR.) dissected to show the poison-bag and sting; the bag is removed from the abdomen, and turned to one side.

2158. The anal segment, with the sting of the Humble Bee.

2159. The sting of the Humble Bee, showing its muscles.

"I have observed," says Mr. Hunter, "that it is only the queen and the labourers that have stings; and this provision of a sting is perhaps as curious a circumstance as any attending the Bee, and probably is one of the characters of the Bee tribe.

"The apparatus itself is of a very curious construction, fitted for inflicting a wound, and at the same time conveying a poison into that wound. The apparatus consists of two piercers, conducted in a groove or director, which appears to be itself the sting. This groove is somewhat thick at its base, but terminates in a point; it is articulated to the last scale of the upper side of the abdomen by thirteen thin scales, six on each side, and one behind the rectum. These scales inclose, as it were, the rectum or anus all round; they can hardly be said to be articulated to each other, only attached by thin membranes, which allow of a variety of motions; three of them, however, are attached more closely to a round and curved process, which comes from the basis of the groove in which the sting lies, as also to the curved arms of the sting, which spread out

externally. The two stings may be said to begin by those two curved processes at their union with the scales, and converging towards the groove at its base, which they enter, then pass along it to its point. They are serrated on their outer edges, near to the point. These two stings can be thrust out beyond the groove, although not far, and they can be drawn within it; and I believe can be moved singly. All these parts are moved by muscles, which we may suppose are very strong in them, much stronger than in other animals; and these muscles give motion in almost all directions, but more particularly outwards. It is wonderful how deep they will pierce solid bodies with the sting. I have examined the length they have pierced the palm of the hand, which is covered with a thick cuticle; it has often been about one twelfth of an inch. To perform this by mere force two things are necessary, power of muscles and strength of the sting, neither of which they seem to possess in sufficient degree. I own I do not understand this operation. I am apt to conceive there is something in it distinct from simple force applied to one end of a body; for if this was simply the case, the sting of the Bee could not be made to pierce by any power applied to its base, as the least pressure bends it in any direction: it is possible the serrated edges may assist, by cutting their way in, like a saw.

"The apparatus for the poison consists of two small ducts, which are the glands that secrete the poison; these two lie in the abdomen, among the air-cells, &c.: they both unite into one, which soon enters into, or forms, an oblong bag, like a bladder of urine, at the opposite end of which passes out a duct, which runs towards the angle where the two stings meet; and entering between the two stings, is continued between them in a groove, which forms a canal by the union of the two stings to this point. There is another duct on the right of that described above, which is not so circumscribed, and contains a thicker matter, which, as far as I have been able to judge, enters along with the other; but it is the first that contains the poison, which is a thin clear fluid. To ascertain which was the poison, I dipped points of needles into both, and pricked the back of the hand; and those punctures that had the fluid from the first-described bags in them grew sore and inflamed, while the

others did not. From the stings having serrated edges, it is seldom the bees can disengage them; and they immediately upon stinging endeavour to make their escape, but are generally prevented, as it were, caught in their own trap; and the force they use commonly drags out the whole of the apparatus for stinging, and also part of the bowels; so that the bee most frequently falls a sacrifice immediately upon having effected its purpose. Upon a superficial view, one conceives that the first intention of the bee having a sting is evident; one sees it has property to defend, and that therefore it is fitted for defence; but why it should naturally fall a sacrifice in its own defence does not so readily appear: besides, all bees have stings, although all bees have not property to defend, and therefore are not under the same necessity of being so provided. Probably its having a sting to use was sufficient for nature to defend the bee, without using it liberally; and the loss of a bee or two, when they did sting, was of no consequence, for it is seldom that more die."

Observations on Bees, Phil. Trans., vol. lxxxii. p. 189.

2160. A large specimen of Centipede (*Scolopendra morsitans*, Linn.), showing the second pair of maxillary feet enormously developed, dilated at their base to contain the poison-gland, and terminated each by a strong curved black claw, which is perforated for the transmission of the venom into the wound which it inflicts.

2161. The stings of three Scorpions (*Scorpio Africanus*, Linn.), variously dissected, to show the structure of this part. In the uppermost one a horizontal section has been removed, to show the two poison-glands, separated from each other by a narrow space: in the middle specimen a vertical section has been removed, to show the continuation of the duct of the gland into the sting; and in the lower one a similar section, together with the glandular substance of the same side, have been removed, to expose the surface of one of the septa shown in the first section: the penultimate segment is preserved in connexion with the sting in the upper and lower specimens, showing the anus surrounded by three valvular processes situated in the under part of the joint, between these segments.

2162. The head of a Rattle-snake (*Crotalus horridus*, Linn.), dissected, to show

the structure of the poison-glands and fangs ; on one side the gland is seen, covered by the fascia of the masseter muscle, and the duct passing through its anterior part to the base of the fang, in the cavity of which a bristle is inserted. On the opposite side the compressor fascia is reflected upwards, showing the gland to be composed of a series of elongated, branched follicles, placed obliquely with respect to the duct, which runs along the lower margin of the gland : the duct is laid open, and a bristle inserted into it, as also into the aperture at the anterior part of the base of the fang, by which the poison passes into its cavity. From the position of the gland it is necessarily compressed by the action of the muscles employed in inflicting the bite : the poison-fangs are by the same act erected and the poison ejected through their canals into the wound. They are attached to a short and moveable superior maxillary bone, and are ordinarily recumbent, and concealed by a fold of the membrane of the mouth, which is here laid open on both sides.

2163. The superior maxillary bone of a poisonous Snake (*Pseudoboa*, Oppel), showing two large poison-fangs which are implanted in it : a portion of wire is passed through the cavity of each.

2164. The head and neck of a Cobra de Capello (*Naja tripudians*, Merrem), with the mouth widely open to show the poison-fangs, which are the only representatives of the exterior or maxillary row of teeth in the upper jaw : the internal or palatal row consists, as in innocuous Serpents, of numerous simple or imperforate teeth. The dilatable integument of the neck, which forms the hood, is expanded, showing the peculiar figure in which the dark pigment is disposed upon its upper surface.

2164 a. The head of a Boa Constrictor, with the mouth widely open, showing the external row of teeth, consisting, like the internal, of numerous simple recurved fangs, similar to those of the palatal row, and constituting the best* distinguishing character hitherto discovered between the non-venomous and venomous Serpents.

Presented by Wm. Clift, Esq. F.R.S.

* It is not, however, a safe or unexceptionable one, since certain poisonous Serpents of the genera *Bongarus* and *Hydrophis* have a series of from three to five imperforate teeth implanted in the superior maxillary bone behind the poison-fangs.

2164 B. The hind leg of the Ornithorhynchus (*Ornithorhynchus paradoxus*, BLUM.), showing the gland situated at the back part of the thigh, and the long duct continued from it to the base of the spur, which is pierced by a canal, like the venomous teeth of Serpents, through which the secretion of the gland is emitted into the wound inflicted by the spur. The nature or degree of the irritating qualities of this secretion have not been accurately determined. *Presented by George Bennett, Esq., F.L.S.*

SERIES X. Animals from the Surface of which is emitted an irritating or urticating Fluid.

2165. The Physalia, or Portuguese Man-of-War (*Physalia pelagica*, LAM.), which produces, when touched, an inflammation of the skin, accompanied with a burning and sometimes a benumbing sensation.

SERIES XI. Animals which secrete a phosphorescent Fluid.

2166. A specimen of the Sea Pen (*Pennatula phosphorea*, LINN.).

2166 A. Two specimens of Pyrosome (*Pyrosoma Atlanticum*, CUV.).
Presented by George Bennett, Esq., F.L.S.

2166 B. A small species of Salpa.

The following note relative to luminous property of this specimen was transmitted with it by the donor, *George Bennett, Esq. F.L.S.*

" March 9th. Therm. 82 to 84, lat. 1° 37′ S., long. 19° 40′ W. At 10 P. M. I again hauled in the towing-net, in which I found only a solitary specimen of Salpa, of a perfectly vitreous transparency. On placing it in a tumbler of sea water in my cabin, which was dark, it gave out a very beautiful phosphorescent light, which proved by the diffusion of the luminosity, how capable the animal was of extending its light to a wide distance: the luminosity subsided as rapidly as it had been given out: on regarding the animal at the time, the phosphoric matter could be seen

exuding from every portion of its transparent body, and then gradually diminishing until the whole of the animal was concealed by the surrounding darkness. No luminosity was voluntarily emitted after the first effort, and even that I attribute rather to the violence with which I plunged the animal in the water, for it never renewed the luminous appearance except when disturbed by the finger, when it would display a faint luminosity of a very brief duration."

Series XII Electric Organs.

This series is illustrated by preparations chiefly from the Torpedo and the Gymnotus, the details of which will be more readily understood after a perusal of the following general description.

"*Of the Torpedo.*

"The electric organs of the Torpedo are placed on each side of the cranium and gills, reaching from thence to the semicircular cartilages of each great fin, and extending longitudinally from the anterior extremity of the animal to the transverse cartilage which divides the thorax from the abdomen; and within these limits they occupy the whole space between the skin of the upper and of the under surfaces: they are thickest at the edges near the centre of the fish, and become gradually thinner towards the extremities. Each electric organ, at its inner longitudinal edge, is unequally hollowed, being exactly fitted to the irregular projections of the cranium and gills. The outer longitudinal edge is a convex elliptic curve. The anterior extremity of each organ makes the section of a small circle, and the posterior extremity makes nearly a right angle with the inner edge. Each organ is attached to the surrounding parts by a close cellular membrane, and also by short and strong tendinous fibres, which pass directly across, from its outer edge to the semicircular cartilages.

"They are covered above and below by the common skin of the animal, under which there is a thin fascia spread over the whole organ. This is composed of fibres, which run longitudinally, or in the direction of the

body of the animal: these fibres appear to be perforated in innumerable places, which gives the fascia the appearance of being fasciculated; its edges all around are closely connected to the skin, and at last appear to be lost, or to degenerate into the common cellular membrane of the skin.

"Immediately under this is another membrane, exactly of the same kind, the fibres of which in some measure decussate those of the former, passing from the middle line of the body outwards and backwards. The inner edge of this is lost with the first described; the anterior, outer, and posterior edges are partly attached to the semicircular cartilages, and partly lost in the common cellular membrane.

"This inner fascia appears to be continued into the electric organ, by so many processes, and thereby makes the membranous sides or sheaths of the columns, which are presently to be described; and between these processes the fascia covers the end of each column, making the outermost or first partition.

"Each organ of the fish under consideration* is about five inches in length, and at the anterior end three in breadth, though it is but little more than half as broad at the posterior extremity.

"Each consists wholly of perpendicular columns, reaching from the upper to the under surface of the body, and varying in their lengths, according to the thickness of the parts of the body where they are placed; the longest column being about an inch and an half, the shortest about one fourth of an inch in length, and their diameters about two tenths of an inch.

"The figures of the columns are very irregular, varying according to situation and other circumstances. The greatest number of them are either irregular hexagons, or irregular pentagons; but from the irregularity of some of them, it happens that a pretty regular quadrangular column is sometimes formed. Those of the exterior row are either quadrangular or hexagonal; having one side external, two lateral, and either one or two internal. In the second row they are mostly pentagons.

* This was eighteen inches long, twelve broad, and in its central or thickest part two inches thick.

" Their coats are very thin, and seem transparent, closely connected with each other, having a kind of loose network of tendinous fibres passing transversely and obliquely between the columns, and uniting them more firmly together. These are mostly observable where the large trunks of the nerves pass. The columns are also attached by strong inelastic fibres, passing directly from the one to the other.

" The number of columns in different Torpedos, of the size of that now offered to the Society, appeared to be about 470 in each organ, but the number varies according to the size of the fish *. These columns increase, not only in size but in number, during the growth of the animal: new ones forming perhaps every year on the exterior edges, as there they are much the smallest. This process may be similar to the formation of new teeth in the human jaw as it increases.

" Each column is divided by horizontal partitions placed over each other at very small distances, and forming numerous interstices, which appear to contain a fluid. These partitions consist of a very thin membrane, considerably transparent. Their edges appear to be attached to one another, and the whole is attached by a fine cellular membrane to the inside of the columns. They are not totally detached from one another: I have found them adhering at different places by blood-vessels passing from one to another.

" The number of partitions contained in a column of one inch in length of a Torpedo which had been preserved in proof spirit, appeared upon a careful examination to be one hundred and fifty: and this number in a given length of column appears to be common to all sizes in the same state of humidity, for by drying they may be greatly altered; whence it appears probable that the increase in the length of a column during the growth of the animal does not enlarge the distance between each partition in proportion to that growth; but that new partitions are formed and added to the extremity of the column from the fascia.

" The partitions are very vascular; the arteries are branches from the vessels of the gills, which convey the blood that has received the influence

* " In a very large Torpedo" (See No. 2176.) " the number of columns in one electric organ was 1182."

of respiration. They pass along with the nerves to the electric organ, and enter with them; then they ramify, in every direction, into innumerable small branches upon the sides of the columns, sending in from the circumference all around upon each partition small arteries, which ramify and anastomose upon it; and passing also from one partition to another, anastomose with the vessels of the adjacent partitions.

" The veins of the electric organ pass out close to the nerves and run between the gills to the auricle of the heart.

" The nerves inserted into each electric organ arise by three very large trunks from the lateral and posterior part of the brain. The first of these in its passage outwards, turns round a cartilage of the cranium, and sends a few branches to the first gill and to the anterior part of the head, and then passes into the organ towards its anterior extremity. The second trunk enters the gills between the first and second openings, and, after furnishing it with small branches, passes into the organ near its middle. The third trunk, after leaving the skull, divides itself into two branches, which pass to the electric organ through the gills; one between the second and third openings, the other between the third and fourth, giving small branches to the gill itself. These nerves having entered the organs, ramify in every direction, between the columns, and send in small branches upon each partition where they are lost.

" The magnitude and the number of the nerves bestowed on these organs, in proportion to their size, must on reflection appear as extraordinary as the phænomena they afford. Nerves are given to parts either for sensation or action. Now if we except the more important senses of seeing, hearing, smelling, and tasting, which do not belong to the electric organs, there is no part even of the most perfect animal, which, in proportion to its size, is so liberally supplied with nerves; nor do the nerves seem necessary for any sensation which can be supposed to belong to the electric organs. And with respect to action, there is no part of any animal, with which I am acquainted, however strong and constant its natural actions may be, which has so great a proportion of nerves.

" If it be then probable that those nerves are not necessary for the purposes of sensation or action, may we not conclude that they are sub-

servient to the formation, collection, or management of the electric fluid; especially as it appears evident, from Mr. Walsh's experiments *, that the will of the animal does absolutely controul the electric powers of its body; which must depend on the energy of the nerves?

"How far this may be connected with the power of the nerves in general, or how far it may lead to an explanation of their operations, time and future discoveries alone can fully determine."—*Hunter, On the Torpedo, Phil. Trans.* lxiii. p. 481.

2167. A large female Torpedo (*Torpedo Galvanii*, Cuv.) entire, to show its external form. This differs from that of other fishes of the Ray-tribe, in the almost circular contour of the disk of the body; the anterior margin of which is formed by two processes of the head, which pass outwards, on either side, to join the pectoral fins; thus circumscribing a space bounded internally by the head and branchiæ, in which the electrical organs are situated.

2168. A small male Torpedo, in which the thinness of the integument permits the situation and form of the electrical organs to be more clearly distinguished. In this specimen, besides the external form, there may be observed the appendages at the posterior edge of the anal fin, which distinguish the sex.

2169. A small female Torpedo, from the East Indies, in which the under surface of the electric organ, on the left side, is exposed.

2170. A large female Torpedo (*Torpedo Galvanii*, Cuv.), having the electric organ, on the right side, exposed by the reflection of the integument and fascia from both its upper and lower surfaces, showing its form and relative situation to the eyes and respiratory apertures. On the left side, the cut edge shows the extent and position of the vertical columns.

2171. The electric organ of the right side of a Torpedo, removed from the body to show its form and extent, and the place of entrance of the large nerves which are subservient to its peculiar functions.

2172. A similar preparation from the left side of a larger Torpedo.

* *Philosophical Transactions*, vol. lxiii. p. 61.

2173. The electric organ of the right side of a Torpedo, having its upper surface exposed; showing the general form of the vertical columns which compose the gland, the relative situation of the gills, and the course of the nerves. On the other side of the preparation is seen the skin which covered the organ, to show its impression.

2174. A female Torpedo (*Torpedo Galvanii*, Cuv.), having the electric organs exposed. On the right side the skin and fascia are removed to show the upper surface of the organ, and the different forms, chiefly hexagonal, of the component columns. On the left side the gland is more exposed, and the nerves supplying the gland are displayed by the removal of the muscles which concealed them. The skin and fascia are turned off, to show the impressions of the upper ends of the columns upon it. Anteriorly, between the two electric glands, may be observed the eyes, which are prominent, and have a lateral or horizontal direction; and behind these are two circular apertures which communicate with the mouth *.

2175. A section of a Torpedo (*Torp. Galvanii*, Cuv.), in which the electric organ, on the left side of the body, is divided horizontally into nearly two equal parts, at the place where the nerves enter, the upper half being turned outwards and still attached to the skin, showing the trunks of the nerves as they emerge from the gills and ramify in the electric organ.

2176. A section of a Torpedo, of very large size, taken in Torbay in August 1774. It weighed fifty-three pounds, was four feet in length, two feet and a half in breadth, and four inches and a half in thickness. Part of the gland on the left side is still remaining. The preparation chiefly shows the immense size of the nerves supplying the gland, and of the medulla oblongata from which they originate, as compared with the size of the brain and medulla spinalis. The first or anterior nervous trunk comes off from the third division of the fifth pair, and does not greatly exceed the size of the corresponding nerve in other species of the Ray-tribe; it distributes branches to the mucous tubes, which are here fewer in number than in the ordinary Rays, before it penetrates the anterior and internal

* This preparation appears to be that from which fig. 1. tab. xx. vol. 63. of the *Phil. Trans.* is taken; except that the figure only represents part of the preparation.

part of the electric organ. The three other trunks are of larger size, and are given off by the pneumogastric or eighth pair; they distribute branches to the gills as they pass along the interspaces of those organs, and also send off the usual nerve to the stomach.

The vessels in this preparation have been carefully and successfully injected, and the high vascularity of the partitions of the columns is clearly demonstrated.

2177. A section of the preceding electric organ, demonstrating the vascularity of the partitions of the vertical columns.

2178. A vertical section of a Torpedo (*Torp. Galvanii*, Cuv.) at the third spiracle, showing the divided muscles of the back, the medulla spinalis, the œsophagus, the left gill split to show the course of the trunk of one of the nerves through it, and the laminated surface of the right gill. The perpendicular columns which compose the electric organ and their horizontal partitions are well displayed in this section; and the trunk of one of the nerves is dissected, to show its manner of ramifying in the substance of the organ.

2179. A small section of the electric organ of a Torpedo, showing the course of a nervous branch between the columns, and the structure of the transverse septa.

2180. A small Electrical Eel (*Gymnotus electricus*, Linn.) entire, to show its external form.

2181. A large *Gymnotus electricus*.

2182. A female *Gymnotus electricus*, in length two feet six inches, of a darker colour.

2183. A similar but larger specimen.

2184. A male *Gymnotus electricus*, of a light colour, two feet seven inches in length (from Surinam).

2185. A large *Gymnotus electricus*, with the integument removed from one side, showing the situation of the electric organs.

These are four in number, and extend, two on each side, from within a

short distance of the pectoral fins to the caudal extremity of the body, occupying the greater part of that space, which seems to be developed exclusively for the lodgement of the electric apparatus, since, besides this, it contains only the bones, muscles, and air-bladder connected with the motions of this part of the body, and the vessels and nerves for the supply of the common parts and the superadded organ. The digestive and generative viscera are confined with the respiratory and circulating organs, the brain and organs of sense, to the small proportion of the body anterior to the electrical apparatus. A bristle is passed into the anus, which opens on the under surface of the head, anterior to the pectoral fins.

Of each lateral pair of electrical organs one is superior and considerably larger than the other; it is displayed on one side through its whole extent in the preparation: the inferior and smaller organ is exposed at its commencement, and through a great part of its posterior extent, by the removal of the superficial stratum of muscular fibres.

The white longitudinal horizontal septa which traverse the electrical organs, and the finer perpendicular laminæ which intersect these interspaces of the preceding, are well displayed.

The structure of the organs is described by Hunter as follows:

"The structure of these organs is extremely simple and regular, consisting of two parts, viz. flat partitions or septa, and cross divisions between them. The outer edges of these septa appear externally in parallel lines nearly in the direction of the longitudinal axis of the body. These septa are thin membranes, placed nearly parallel to one another. Their lengths are nearly in the direction of the long axis, and their breadth is nearly the semidiameter of the body of the animal. They are of different lengths, some being as long as the whole organ. I shall describe them as beginning principally at the anterior end of the organ, although a few begin along the upper edge; and the whole, passing towards the tail, gradually terminate on the lower surface of the organ; the lowermost at their origin terminating soonest. Their breadths differ in different parts of the organ. They are in general broadest near the anterior end, answering to the thickest part of the organ, and become gradually narrower towards the tail; however, they are very narrow at their beginnings or anterior ends.

Those nearest to the muscles of the back are the broadest, owing to their curved or oblique situation upon these muscles, and grow gradually narrower towards the lower part, which is in a great measure owing to their becoming more transverse, and also to the organ becoming thinner at that place. They have an outer and an inner edge. The outer is attached to the skin of the animal, to the lateral muscles of the fin, and to the membrane which divides the great organ from the small; and the whole of their inner edges are fixed to the middle partition formerly described, also to the air-bladder; and three or four terminate on that surface which inclose the muscles of the back. These septa are at the greatest distance from one another at their exterior edges near the skin, to which they are united; and as they pass from the skin towards their inner attachments they approach one another. Sometimes we find two uniting into one. On that side next to the muscles of the back they are hollow from edge to edge, answering to the shape of those muscles; but become less and less so towards the middle of the organ; and from that towards the lower part of the organ, they become curved in the other direction. At the anterior part of the large organ, where it is nearly of an equal breadth, they run pretty parallel to one another, and also pretty straight; but where the organ becomes narrower, it may be observed in some places that two join or unite into one, especially where a nerve passes across. The termination of this organ at the tail is so very small that I could not determine whether it consisted of one septum or more. The distances between these septa will differ in fishes of different sizes. In a fish of two feet four inches in length I found them one twenty-seventh of an inch distant from one another; and the breadth of the whole organ, at the broadest part, about an inch and a quarter, in which space were thirty-four septa. The small organ has the same kind of septa, in length passing from end to end of the organ, and in breadth passing quite across; they run somewhat serpentine, not exactly in straight lines. Their outer edges terminate on the outer surface of the organ, which is in contact with the inner surface of the external muscle of the fin, and their inner edges are in contact with the centre muscles. They differ very much in breadth from one another; the broadest being equal to one side of the triangle,

and the narrowest scarcely broader than the point or edge. They are pretty nearly at equal distances from one another; but much nearer than those of the large organ, being only about one fifty-sixth part of an inch asunder; but they are at a greater distance from one another towards the tail, in proportion to the increase of breadth of the organ. The organ is about half an inch in breadth and has fourteen septa. These septa, in both organs, are very tender in consistence, being easily torn. They appear to answer the same purpose with the columns in the *Torpedo*, making walls or butments for the subdivisions, and are to be considered as making so many distinct organs. These septa are intersected transversely by very thin plates or membranes, whose breadth is the distance between any two septa, and therefore of different breadths in different parts; broadest at that edge which is next to the skin; narrowest at that next to the centre of the body, or to the middle partition which divides the two organs from one another. Their lengths are equal to the breadths of the septa, between which they are situated. There is a regular series of them continued from one end of any two septa to the other. They appear to be so close as even to touch. In an inch in length there are about 240, which multiplies the surface in the whole to a vast extent."

"*Of the Nerves.*

"The nerves in this animal may be divided into two kinds: the first, appropriated to the general purposes of life; the second, for the management of this peculiar function, and very probably for its existence. They arise in general from the brain and medulla spinalis, as in other fish; but those from the medulla are much larger than in fish of equal size, and larger than is necessary for the common operations of life. The nerve which arises from the brain and passes down the whole length of the animal (which I believe exists in all fish) is larger in this than in others of the same size, and passes nearer to the spine. In the common Eel it runs in the muscles of the back, about midway between the skin and spine. In the Cod it passes immediately under the skin. From its being larger in this fish than in others of the same size, one might suspect that

it was intended for supplying the organ in some degree; but this seems not to be the case, as I was not able to trace any nerves going from it to join those from the medulla spinalis, which run to the organ. This nerve is as singular an appearance as any in this class of animals; for surely it must appear extraordinary that a nerve should arise from the brain to be lost in common parts, while there is a medulla spinalis giving nerves to the same parts. It must still remain one of the inexplicable circumstances of the nervous system. The organ is supplied with nerves from the medulla spinalis, from which they come out in pairs between all the vertebræ of the spine. In their passage from the spine they give nerves to the muscles of the back, &c. They bend forwards and outwards upon the spine between it and the muscles, and send out small nerves to the external surface, which join the skin near to the lateral lines. These ramify upon the skin, but are principally bent forwards between it and the organ, into which they send small branches as they pass along. They seem to be lost in these two parts. The trunks get upon the air-bladder, or rather dip between it and the muscles of the back, and continuing their course forwards upon that bag, they dip in between it and the organ, where they divide into smaller branches; then they get upon the middle partition, on which they continue to divide into still smaller branches; after which they pass on and get upon the small bones and muscles, which are the bases for the under fin, and at last they are lost on that fin. After having got between the organ and the above-mentioned parts, they are constantly sending small nerves into the organs; first into the great organ, and then into the small one; also into the muscles of the fin, and at last into the fin itself. These branches, which are sent into the organ as the trunk passes along, are so small that I could not trace their ramifications in the organs. In this fish, as well as in the *Torpedo*, the nerves which supply the organ are much larger than those bestowed on any other part for the purposes of sensation and action; but it appears to me that the organ of the *Torpedo* is supplied with much the largest proportion. If all the nerves which go to it were united together, they would make a vastly greater chord than all those which go to the organ of this Eel. Perhaps when experiments have been made upon this fish equally ac-

curate with those made upon the *Torpedo*, the reason for this difference may be assigned."

"*Blood-vessels.*

"How far this organ is vascular I cannot positively determine, but from the quantities of small arteries going to it, I am inclined to believe that it is not deficient in vessels. The arteries arise from the large artery which passes down the spine; they go off in small branches like the intercostals in the Human subject, pass round the air-bladder, and get upon the partition together with the nerves, and distribute their branches in the same manner. The veins take the same course backwards and enter the large vein which runs parallel with the artery."—*Phil. Trans.* 1775, p. 399.

2186. A section of the anterior part of the body of a *Gymnotus electricus*. The skin is removed as far back as the upper or dorsal edge of the organ and, together with the muscles, from part of the vertebral column, medulla spinalis, &c. There are several pieces or sections taken out of the organ, which expose everything that has any relation to it. At the upper and lower ends of the preparation the organ is entire, the skin only being removed. Near the middle of the preparation, adjoining the belly fin, is a small portion of the smaller electric organ. The partition which divides the two large organs, the air-bladder, the medulla spinalis, and the nerves going to the organ, are also here shown; together with the lateral nerve, which gives no branches to the organ, although it is itself a branch of the eighth pair; which supplies the greater part of the nervous energy to the electrical organ of the Torpedo*.

2187. A transverse section of a *Gymnotus electricus*, exposing at one view all the parts connected with the electric organ, viz. the external surface of the side of the fish, the under fin, the cut ends of the muscles of the back, the cavity of the air-bladder, the body of the spine, the medulla spinalis, the large artery and vein, the cut ends of the large and small electric organs, and the partition that divides the organs of one side from those of the other†.

* This preparation is figured in *Phil. Trans.* 1775. Plate III. fig. 4.

† See *Phil. Trans.* 1775. Plate III. fig. 4.

2188. A transverse section of a *Gymnotus electricus*, showing the same parts as are described in the last preparation. A portion of the electric organ has been removed from one side, to show the manner in which the nerves are distributed in its substance.

2189. A fine specimen of the Electric Silurus (*Malapterurus electricus*, Lacép.). This fish is so called from its possessing, like the Torpedo and Gymnotus, the faculty of giving electric shocks: the seat of this power appears to be a peculiar tissue of an adipose and cellular texture, the latter consisting of filaments which decussate each other in every direction, and intercept very fine meshes. This substance is extended beneath the integument from the branchial aperture to within a short distance of the caudal fin: it is separated from the subjacent muscles by an aponeurotic membrane, which immediately forms an investment, and which is itself surrounded by a stratum of fat, serving to isolate the electric organ from the surrounding parts. The nerves of this organ are stated to be derived from the lateral nerve, which is a branch of the eighth pair. The organ has not been dissected in the specimen.

Series XIII. Reproduction of parts of the Body.

A. *Reproduction of the external Integument.*

2190. The cuticular covering of a Snake (*Natrix fusca*, Cuv.), which is periodically shed and renewed in one continuous and entire piece. The reproduction of the new cuticle produces a detachment of the old from the subjacent living parts, and it then loses part of its transparency and smoothness. As it is continued over the cornea, the sight of the animal is dimmed: its motions are also in some degree cramped, and it seeks to free itself of the incumbrance by rubbing the sides of its mouth against any rough and hard resisting substance. The old cuticle is thereby detached from the circumference of the mouth, and turned back over the head; and the impediment to vision being thus removed, the Snake proceeds with more vigour and rapidity to detach and turn back the cuticle,

by repeating the same actions with which it commenced the operation; and at length it literally creeps out of its skin, which is left inverted, and more or less entire, according to the degree of health and vigour of the animal at the time of the operation.

2190 A. The cast cuticle or exuvium of a Snake, very entire.

Presented by Sir J. Banks, Bart.

2190 B. A portion of the cast cuticle of the Slow-worm (*Anguis fragilis*, Linn.), which is not inverted in the act of shedding. *Presented by Mr. Clift.*

2190 C. A portion of the cast cuticle of an Eft. *Presented by Mr. Clift.*

2191. A River Lobster, or Craw-fish (*Astacus fluviatilis*, Linn.), taken in the month of July, when their crustaceous cuticle is cast and reproduced. The present specimen shows the separation of the carapace or thoracic shield, and of the crustaceous segments covering the tail, which are previously softened, and rendered more dilatable and flexible by the absorption of a portion of the calcareous constituent.

2192. A Craw-fish, in which the separation and regeneration of the crust is further advanced. One half of the old and now softened and transparent crust has been removed from the body, to show the new-formed covering beneath. A strip of the old crust has been taken off the right chela, or forceps-claw, for the same purpose.

2193. A similar preparation.

2194. A longitudinal vertical section of a Craw-fish, showing the old and new crusts, both in a soft state, but especially the latter, and the commencement of the deposition of the round mass of calcareous matter between the internal and muscular coats of the stomach, at its anterior and lateral part. The increase of this substance takes place by the successive deposition of laminæ progressively increasing in size on its exterior part.

2195. The opposite section of the same Craw-fish. The lines of growth of the gastric calcareous body, described in the last preparation, may be distinctly seen by means of a lens on its inner surface.

2196. A Craw-fish, with the parietes of the thorax and stomach in part removed,

to show a further stage of growth of the gastric concretions. On the right side the situation of this body between the cuticular and glandular tunic of the stomach is distinctly shown.

2197. The anterior half of a Craw-fish, with the parietes of the thorax and stomach removed on the right side, to show the gastric calcareous body, which has acquired its full size.

2198. The anterior part of a Craw-fish, with the parietes of the thorax removed, to show the appearance of the stomach when the temporary calcareous bodies are fully developed. These are convex externally, but slightly concave towards the cavity of the stomach; their development in that direction being probably opposed by the pressure of the contained food.

2199. The stomach of a Craw-fish, showing the calcareous matter last accumulated between its parietes, deposited in the form of small tubercles on the exterior convex surface of the gastric concretion.

2200. The stomach of a Craw-fish, after the shedding of its cuticular lining and teeth, and the detachment of the calcareous bodies into its interior. These, it is said, are not rejected by the mouth, but are broken up by the new-formed gastric teeth, and pass again into the system to be employed in calcifying the new-formed cuticle.

2201. A series of the gastric concretions in different stages of formation. These substances were formerly used in medicine under the name of Crab's eyes (*oculi cancrorum*).

2202. A Craw-fish, which has cast its old shell, and has the new one in progress of calcification. The parietes of the thorax and stomach are removed from the right side, to show the corrugated and thickened part of the parietes of the stomach, from which the gastric concretion has been detached.

2203. A similar preparation.

2204. A Craw-fish with part of the parietes of the thorax and stomach removed, to show the new-formed cuticular lining of the stomach and gastric teeth; and the circular impressions corresponding to the gastric concretions.

2204 A. A Lobster (*Astacus marinus*, Linn.) taken at the period of casting its

shell. The carapace has not undergone any softening process, but is split in two pieces by a longitudinal division, extending along the middle line of the back to the extremity of the rostrum, and has been thus detached from the soft, new-formed cuticle beneath.

Presented by Sir Anthony Carlisle, F.R.S.

B. *Reproduction of extremities.*

2205. A young Lobster, showing the reproduction of the greater part of both *chelæ*, after an accidental loss of those parts. The portions reproduced are the last four segments, which have their usual proportions to one another, but are very small as compared with the size of the body.

2206. The two basal joints of the chela of a Lobster, supporting the last four segments reproduced, but of very diminutive size.

2207. A similar preparation from a larger Lobster, showing a reproduction of the four last segments of the chela, the divisions of which are less distinctly marked than in the younger specimen, in which the powers of reparation are more vigorous.

2207 A. The anterior part of a Lobster, showing the imperfect reproduction of the left external antenna; and also of the third, fourth, and fifth thoracic feet of the same side. *Presented by Sir Everard Home, Bart.*

2208. A Gecko (*Gecko verus*), showing the posterior half of the tail regenerated; it has acquired the full size, but the scales on the new-formed part are small and irregular in their disposition.

2209. Two portions of a regenerated tail of a Gecko, showing the mode in which the small muscles of each segment are indented by angular processes one into another.

2210. A Lizard (*Lacerta agilis*, Linn.), which has lost its tail.

2211. A Lizard (*Lacerta bilineata*, Linn.), similarly mutilated.

2212. Sections of the tail of a Lizard, showing the short muscles which are attached to each segment of the tail; the arrangement of which admits of that part being broken off with great facility. When this happens the tail continues to move and writhe for some time, and when these motions

have ceased, as it were from fatigue, they recommence when the tail is pricked or otherwise irritated.

2213. A Lizard (*Lacerta agilis*, Linn.), showing the regeneration of the extremity of the tail.

2214. A similar specimen.

2215. A Lizard, with a considerable part of the tail very completely regenerated.

2216. The same species of Lizard, in which the greater part of the tail has been regenerated, the extremity of which has been broken off and a second time reproduced.

2217. A Lizard (*Lacerta ocellata*, Linn.), showing, in like manner, a second growth from the extremity of a reproduced tail.

2218. The tail of a Lizard, showing two successive reproductions.

2219. A Lizard (*Lacerta agilis*, Linn.), the tail of which has been wounded on one side, and the reproductive power so stimulated, as caused the commencement of the growth of a second tail from that part.

2220. The same species of Lizard, showing the production of a second tail near the extremity of the first, in consequence of a wound at that part.

2221. A Lizard (*Ameiva vulgaris*, Cuv.), showing a more extensive growth of a second tail, from a similar cause.

2222. A larger specimen of the same species of Lizard, showing the growth of a second tail, in consequence of a wound near the base of the first.

2223. A Lizard, in which two tails appear to have been equally reproduced.

Fig. 1.

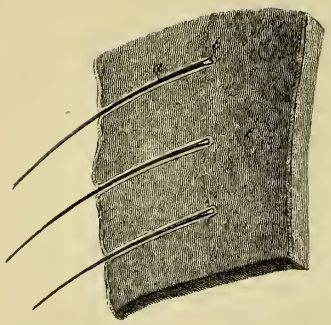


Fig. 2.

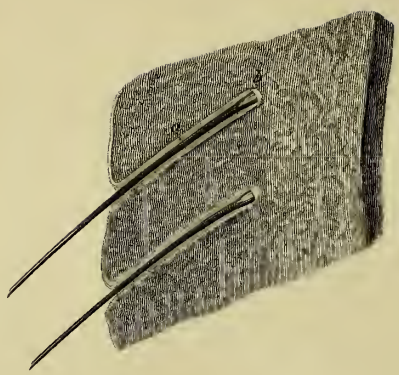


Fig. 3.

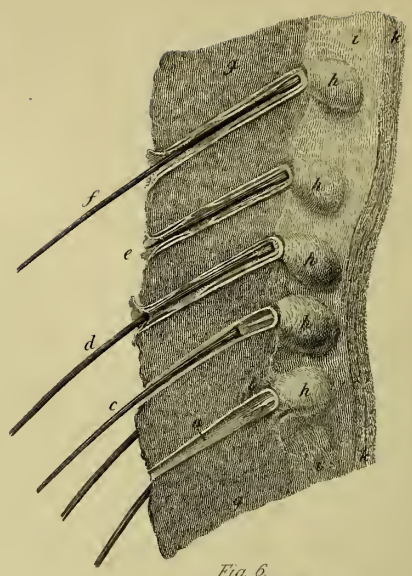


Fig. 4.

Fig. 5.

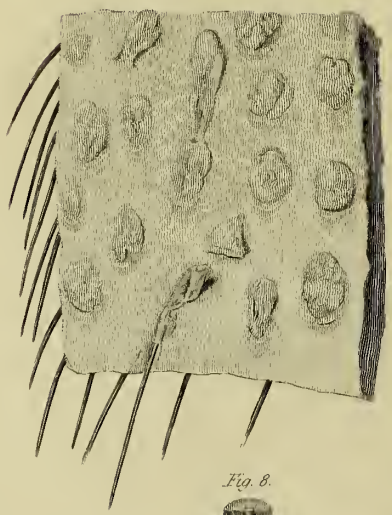


Fig. 6.

Fig. 7.

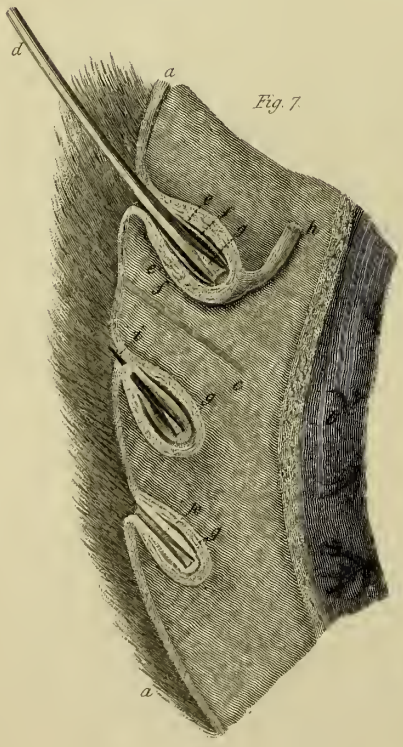


Fig. 8.

Fig. 9.

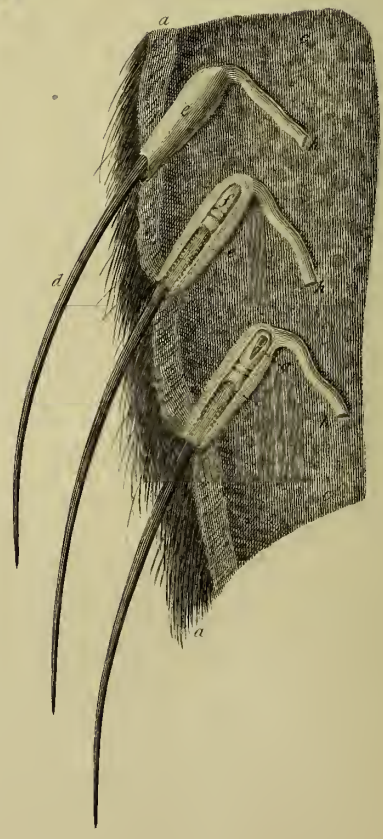
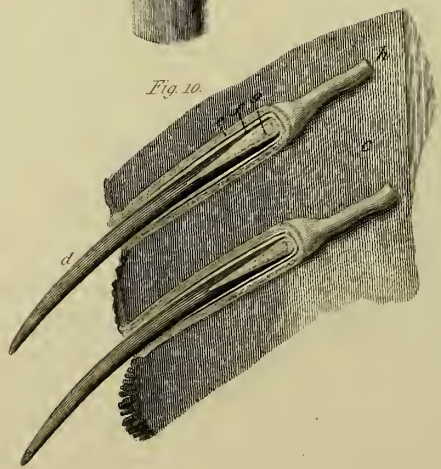


Fig. 10.



DESCRIPTION OF THE PLATES.

PLATE XLIII.*

STRUCTURE AND GROWTH OF HAIR.

Fig. 1. " A section of the scalp of the Human subject, magnified, in which there are three hairs growing.

" *a*, The theca of the root and base of the hair.

" *b*, The pulp.

" *e*, A clouded granulated substance, having the appearance of being glandular.

Fig. 2. " A section of the skin of the tail of a Horse, magnified, in which two hairs are seen.

" *a*, The sheath of the hair.

" *b*, The pulp upon which the hair grows.

Fig. 3, 4, 5. " Hair and bristles of the Hog: these are of the second kind, or what may be called ' deciduous hair'." (See p. 242.)

Fig. 3. represents a slice of the skin of the back of a Boar, magnified, in which are seen five bristles, showing the mode of growth to their full perfection.

a, The theca of a growing bristle: the bristle has been pulled out leaving the pulp at *b*.

c, A growing bristle, pulled out so far only as to expose the pulp.

d, A growing bristle in its place.

e, A young bristle, which has hardly pierced the skin.

f, A full-grown bristle, having no pulp, and terminating in a small neck.

g, *g*, The corium or true skin.

h, *h*, Pulpy substances at the root of each bristle.

i, *i*, Subcutaneous cellular tissue.

k, *k*, Panniculus carnosus.

* Nos. 124, 125, *Manuscript Catalogue of Drawings.*

Fig. 4. A section of the skin from the body of a Hog, not so much magnified as in fig. 3, showing that the common hair has the pulpy substance leading from the root.

a, The cut edge of the skin through which the bristles pass.

b, The inner surface of the skin.

Fig. 5. The inner surface of a portion of the same skin, showing the pulpy substances leading to the root of each hair.

Fig. 6. A portion of the skin covering the tail of a Rhinoceros, natural size, showing a single bristle in its theca, the growth of which being completed, the pulp has been absorbed and the root of the hair diminished to a point, so that further growth was impossible.

Fig. 7. A section of the lip of a Lion, magnified, showing the mode of growth of whiskers.

a, The external skin and hair of the lip.

b, The smooth inner surface of the lip.

c, The cut surface.

d, One of the whiskers.

e, The external theca of the whiskers.

f, The internal theca.

g, The pulp upon which the whisker is formed.

h, The nerve going to the pulp.

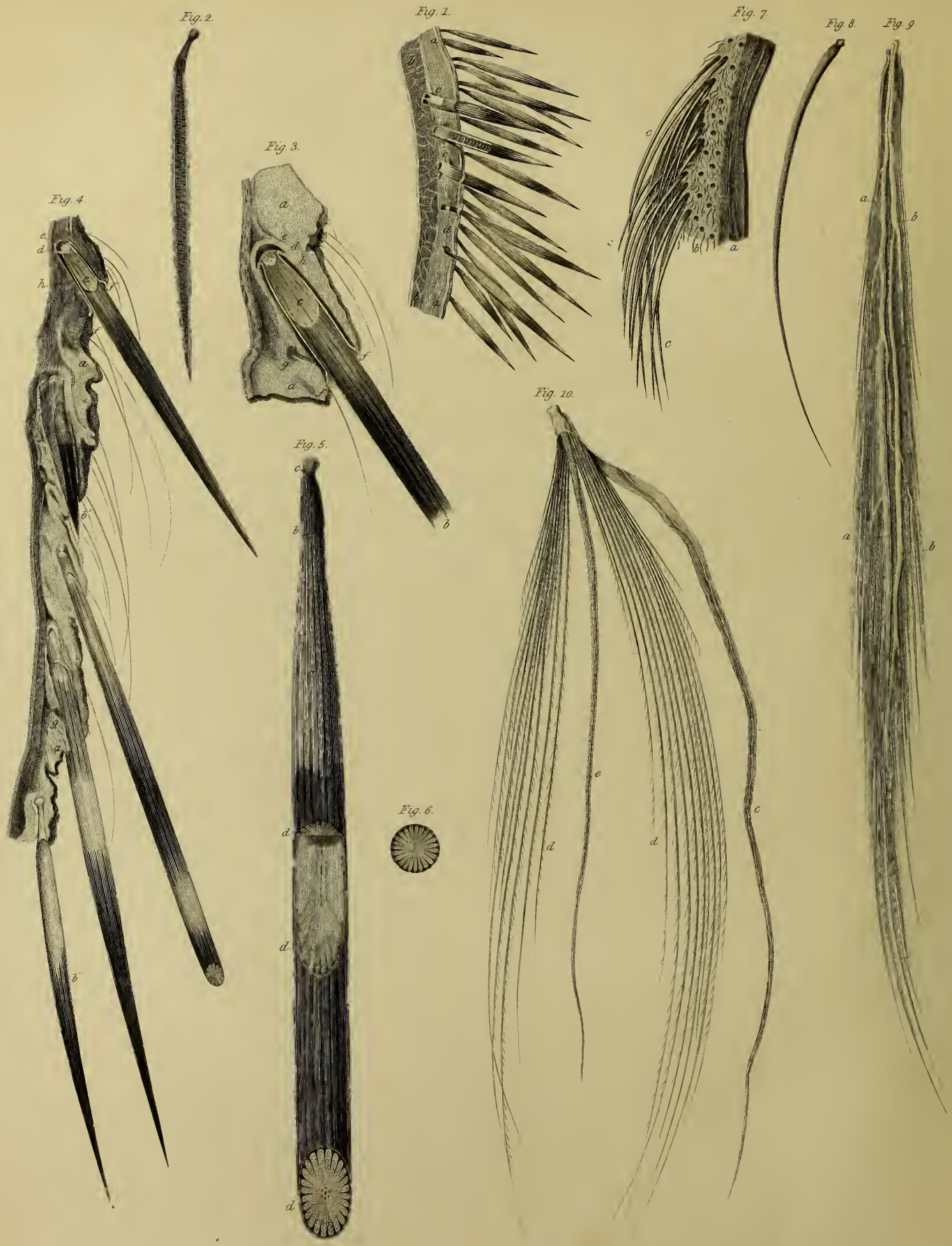
i, The point of a young whisker just passing through the skin ; with the outer and inner sheaths laid open to expose the base.

k, The cavity of the inner sheath exposed by the extraction of the whisker; the pulp (*g*) being left adhering to the sheath by its base.

Fig. 8. The root of one of the whiskers of a Lion, with the formative pulp, minutely injected, and exposed by an oblique section ; much magnified. The ramifications of the nutrient artery are seen in the pulp.

Fig. 9. A section of the lip of a Sea-Lion (*Phoca jubata*, Gmel.). The same letters indicate the same parts as in fig. 7.

Fig. 10. A section of the lip of a Walruss (*Trichecus Rosmarus*, Linn.), exposing two whiskers *in situ*, natural size. The same letters indicate the same parts as in fig. 7.



W.m Bell. del

L.t Bauer. sc.

PLATE XLIV.

STRUCTURE AND GROWTH OF QUILLS AND DOWN.

Fig. 1.* "A section of the skin of a Hedgehog (*Erinaceus Europæus*, Linn.), in which are seen prickles of different growths.

"The quills or prickles of a Hedgehog grow very much like hair, viz. from a pulp. When they first begin to be formed they are situated very deep, quite through the cutis as far as the panniculus carnosus (which in the Hedgehog is very strong); but as they increase in size they rise higher and higher, till at last only a little of the neck and the knob on the end is in the skin; which is probably to allow of motion to that part of the prickle which is projecting out of the skin."

a, The cut edge of the skin.

b, The cut edge of the strong panniculus carnosus which lines the skin.

c, *c*, Young quills which may be observed to be as deep as the cutis is thick.

d, Points to the roots of completely formed prickles, in which, by the absorption of the pulp, a small neck has been formed terminated by a little round knob, the part which fixes the quill to the skin.

Fig. 2. A completely formed prickle or quill cut longitudinally and magnified, showing that it is hollow and filled with a pithy substance, which is transversely disposed so as to divide the cavity into many sections.

Fig. 3.† A section of the skin with a growing quill of a Porcupine (*Hystrix cristata*, Linn.), magnified.

a, *a*, The cut edge of the skin.

b, The body of the quill.

c, The surface whence a slice has been taken.

d, The fluted pulp, upon which the quill grows; it is attached by a thin membrane to the sides of the bottom of the theca.

e, A cavity below the pulp and its attaching membrane, between the base of the pulp and the bottom of the theca, to which therefore the pulp does not adhere.

f, A kind of cuticle to the quill, which is formed by the theca, and which, rising with the quill, breaks off in scales as it is projected beyond the surface of the skin.

* No. 127. *Manuscript Catalogue of Drawings.* † No. 126. *Manuscript Catalogue of Drawings.*

g, A sebaceous follicle, the duct of which conveys the unctuous secretion into the theca of the quills.

h, The theca or sheath of the quill; like that of hair, it is double.

Fig. 4. A slice of the skin of a Porcupine, in which are several quills at different stages of growth. The same letters indicate the same parts as in fig. 3.

b', is a young quill just pointing through the skin.

b'', is a completely formed quill, where the pulp is all expended, and has formed a neck to the quill in the progress of its diminution, and at last a bulb.

Fig. 5. A portion of a large quill to show its structure.

a, The body of the quill.

b, The neck.

c, The bulbous root, or that part which is fastened to the skin.

d, Cut surfaces showing horny longitudinal partitions passing from the circumference to the centre, the interstices of which are filled with a kind of pith.

Fig. 6. A transverse section of the same quill, which gives a direct view of the converging partitions.

The middle pithy substance is secreted by the pulp, the surface of which being grooved the pith is fluted; the grooves of the pith are filled up by the horny secretion of the capsule, which constitutes the converging laminæ, so that the exterior of the quill is smooth and uniform, as shown in fig. 6; although from the transparency of the outer horny substance, which allows the white pulp in the interstices of the laminæ to be seen, the quill itself appears at first sight to be fluted.

Fig. 7 to 10.* are of the down of a Gosling, before exclusion, three weeks after incubation had commenced.

Each portion of down is at this period covered by a very thin epidermal sheath, which, by drying immediately upon hatching, cracks and breaks off, and allows the component filaments to separate and expand.

Fig. 7. shows the down of the Gosling in its enveloped state, considerably magnified.

a, The cut edge of the skin and muscles.

* No. 123. *Manuscript Catalogue of Drawings.*

Fig. 3.

Fig. 1.

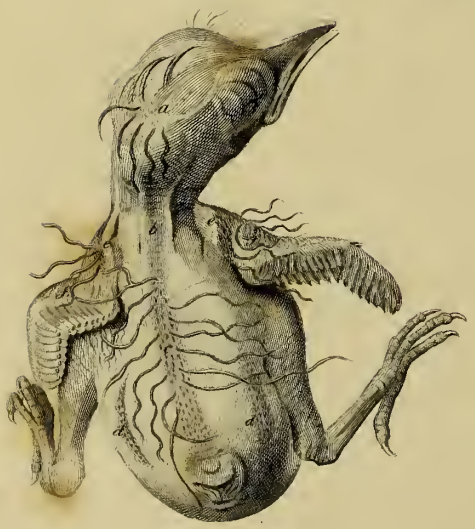


Fig. 2.

Fig. 4.

b, The surface of the skin plucked of its down, on which may be observed small hairs.

c, The down-fascicles inclosed in their thecæ.

Fig. 8. A single fascicle of the down more highly magnified and inclosed.

Fig. 9. The same still more magnified, with the theca slit open, showing the vascularity of the whole part, and that the blood-vessels *a b* are not confined to the centre of the substance of the down, but ramify and run along with it.

Fig. 10. In this figure the theca (*c*) is turned off to one side, and the feathery parts of the down *d d* separated, which exposes a substance *e* running from the stem along the centre of the bundle of feathery filaments.

PLATE XLV.

DISPOSITION AND GROWTH OF FEATHERS.

"*Of the Situation of Feathers.*

"Although the feathers of Birds appear to be an entire and uniform covering, they do not arise equally from every part of the body, but only from such parts of the skin as are least liable to be affected by the motion of the contiguous parts, such as the motion of the limbs.

"The feathers arise pretty equably on the head where there is no motion; and along the back; on the wings between joint and joint; as also on the thighs and legs: the whole making a kind of partial coat of mail. As they do not arise from every part of the skin equally, they must be proportionately thick-set where they do arise.

"The places of origin of feathers are very observable in a bird that has been plucked; but still more so in young birds just feathering, more especially of such as have but little down, and of which the clumps of feathers, from their colour, as in the young Blackbird, present a great contrast with the skin.

"In the interstices of the chumps of feathers there are others disposed irregularly, but so sparingly as not to interfere with the motion of the part.

"To these groups or thickets of feathers I shall give particular names, taken from their situation.

[The figures in the following Plate are diminished views of young Blackbirds at different stages, to show the progress of the feathers forming the clumps situated on the back part of the body.]

Fig. 1. gives the appearance of the feathers as when they are just protruding through the skin. The filamentary bodies are the down-fascicles.

" *Fig.* 2. A young Blackbird, a few days older, where these clumps of feathers are more distinct, and the flight-feathers are also in progress of development.

" *Fig.* 3. is still further advanced, and the carpal and metacarpal feathers are beginning to show themselves.

" *Fig.* 4. In this the tail-feathers are beginning to shoot forth, and the feathers of each thicket are spreading so far as to partially cover the naked parts. The same letters indicate the same parts in each figure.

a, The cranial clump.

b, The posterior cervical clump.

c, The dorsal clump.

d, *d*, The lumbar clumps.

e, *e*, The brachial clumps.

f, *f*, The ante-brachial clumps.

g, *g*, The carpal clumps.

h, *h*, The stronger feathers that cover the quill-feathers, called the 'greater coverts' (*tectrices secundæ*, Linn.).

i, *i*, The great quill-feathers called 'primaries' (*primores*, Linn.).

k, *k*, The quill-feathers from the ante-brachium called 'secondaries' (*secondariæ*, Linn.).

l, The femoral tufts.

m, The quill-feathers of the tail, or *rectrices*.

PLATE XLVI.

Fig. 1 to 4. Anterior views of the same birds, as in the preceding Plate, showing the clumps of growing feathers on the fore part of the body.

n, *o*, The anterior cervical and pectoral clumps.

Fig. 3

Fig. 1

Fig. 2

Fig. 4

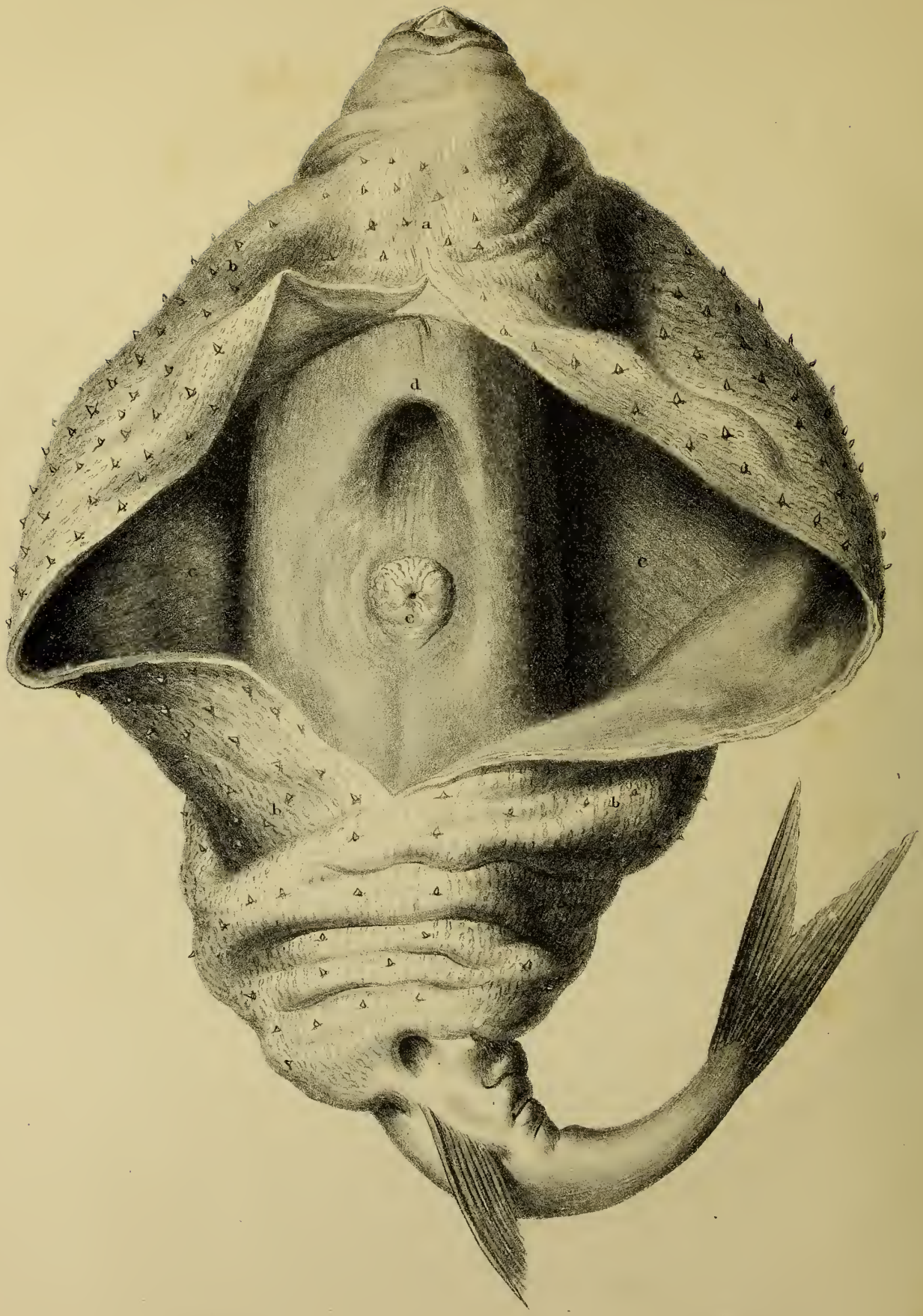

a
b
d
c
c
c
b
b

Fig. 1.

Fig. 2.

Bell. del.

J. T. Wedgwood. sculp.

p, *p*, The abdominal clumps.

q, *q*, The femoral clumps.

PLATE XLVII.*

The figure in this plate is taken from the large specimen of Crop-fish or Globe-fish (*Tetrodon Pennantii*, YARRELL,) (No. 2095.). The abdominal parietes (*a b*) and those of the œsophageal dilatation forming the air-bag are laid open to show the smooth internal surface of the air-bag *c*, the opening into the first œsophagus *d*, and the valvular passage to the second œsophagus *e*.

PLATE XLVIII.

THE PREPUTIAL AND ANAL SCENT-GLANDS OF THE BEAVER (*Castor Fiber*, LINN.).

Fig. 1.† "The anus of the Beaver, with part of the surrounding skin and tail; which is principally to show that when the anus is well drawn in, the prepuce and openings of the castor ducts may also be drawn in and appear to open within the anus.

" *a*, *a*, The inner surface of the anus protruding.

" *b*. The passage leading into the gut (rectum).

" *c*, *c*, The orifices of the two castor ducts.

" *d*, The orifice of the prepuce."

Fig. 2.‡ This drawing exposes the external parts of generation of the Beaver, with several other parts connected with them, although not immediately so, as respects the use of those parts.

" What appears to be the verge of the anus in this animal, when the penis is not erect, seems to be common to the rectum and penis; something like what the labia pudendi in the human body are to the clitoris, meatus urinarius, and vagina. These parts project much further beyond the ossa pubis in this animal than in most others; and this probably for the convenience of the large glands on the sides of the anus, which could not have room within the pelvis. To point out

* No. 15. *Manuscript Catalogue of Drawings.* † No. 134. *Ibid.* ‡ No. 135. *Ibid.*

the situation of these parts, respecting the first part of the body, the following reference will be necessary.

" *a*, *a*, The ossa pubis.

" *b*, *b*, The tail.

" *c*, *c*, The posterior edges of the two thighs.

" *d*, The large lateral swelling including two glandular bags covered by one general coat, which is partly muscular. On the opposite side are the two bags exposed, having the common covering removed, and which sent down a partition between the two.

" *e*, The castor-bag, which opens at the side of the penis, or outside of the prepuce, at *f*.

" *g*, The other bag (which contained a thick fatty mucus) having two openings into it, both which terminate at *h*, in which there are two bristles.

" *i*, The anus.

" *k*, The penis with the end cut off."

Hunterian manuscript Catalogue of Drawings.

END OF VOL. III.

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